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NOT MEASUREMENT SENSITIVE

MIL-PRF-TRNRS

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SUPERSEDING

MIL-T-81821

25 March 1983

## PERFORMANCE SPECIFICATION

### TRAINERS AND TRAINING EQUIPMENT

This specification is approved for use by all Departments and Agencies of the Department of Defense.

#### 1. SCOPE

1.1 Scope. This performance specification for trainers (see 6.5.2.v) and training equipment (see 6.5.2.z) establishes requirements for hardware and software, constructed or modified exclusively for training purposes. The word "trainer" hereafter used in this document is meant to include both trainers and training equipment. These requirements for trainers involve simulation or stimulation in construction or operation to demonstrate or illustrate a concept, simulation of an operational circumstance, environment, or mission. These requirements also include simulation or stimulation that allows operators, maintainers, leaders, supervisors, and military organizations to learn and demonstrate proficiency. The scope of items specified herein will supply the using activity with items required to demonstrate, instruct, and provide practical experience in the employment, operation, servicing, adjustment, calibration, fault isolation, troubleshooting, repair, and maintenance of the related end item (see 6.5.2.e) and subsystems. This specification may be used by the Government and contractors for the acquisition of trainers and associated software.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Air Warfare Center Aircraft Division, Code 414100B120-3, Highway 547, Lakehurst, NJ 08733-5100, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1.2 Classification. While there are many ways to group types of equipment used for training, this document will deal with two primary classifications of equipment required for training, they are: 1) trainers, and 2) training equipment. These classifications shall not limit or preclude the development of additional or different types. Combinations of trainers can be used to develop mission and scenario training systems to support individual and collective training.

1.2.1 Trainers. There are many nomenclatures for trainers. For the purpose of this specification, there are three (3) categories of trainers referred to. Trainers are a relatively complex item of training equipment, using electronic, mechanical, or electronic and mechanical means to reproduce conditions required for student(s), to practice operator, maintainer, or other exercises to successfully accomplish the learning objective(s). Trainer types are as follows:

1.2.1.1 Platform and component trainers. Platform and component trainers (see 6.5.2.q) utilize actual system components that function in the same manner as when installed in the end item and subsystems. These trainers use actual systems, subsystems, and assemblies. These systems, subsystems, and assemblies are located in the trainer to represent their actual location in the end item and subsystems. The trainer will be equipped with actual wiring, plugs, mounting racks, securing devices, and other hardware required to enhance the realism of training.

1.2.1.2 Simulator trainers. Simulator trainers (see 6.5.2.r) reproduce the functions of actual equipment, systems, scenarios, or hostile environments by synthetically providing a desired condition or set of conditions.

1.2.1.3 Combination platform/component/simulator (i.e., hybrid) trainers. Combination platform/component/simulator (i.e., hybrid) trainers (see 6.5.2.b) are a combination of platform systems utilizing actual components and simulated components functioning to provide a replica of the systems as installed. Hybrid trainers can be constructed with varying combinations of hardware and simulation dependent upon specified learning objectives. Actual system components may be used, represented, stimulated, simulated, presented, or a combination of these methods may be used.

1.2.2 Training equipment. Training equipment includes end items or systems that have been modified for training. Training equipment also includes equipment groups, mock-ups, animated displays, task trainers, function trainers, and other equipment and software necessary to support the transfer of knowledge and skills.

1.3 Training data products. Training data products that support trainer functionality shall be in accordance with MIL-PRF-29612.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has

been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

## 2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

### SPECIFICATIONS

MIL-PRF-29612	Training Data Products
MIL-PRF-39006/22	Capacitors, Fixed, Electrolytic (Non-solid Electrolyte), Tantalum, (Polarized, Sintered Slug), 85 C (Voltage Derated to 125 C), Established Reliability, Style CLR79

### STANDARDS

#### FEDERAL

FED-STD-595	Colors used in Government Procurement
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#### DEPARTMENT OF DEFENSE

MIL-STD-129	Standard Practice for Military Marking
MIL-STD-461	Requirements for the Control of Electromagnetic Interference Characteristics of Subsystem and Equipment
MIL-STD-464	Electromagnetic Environmental Effects Requirements for Systems
MIL-STD-790	Established Reliability and High Reliability Qualified Products List (QPL) Systems for Electrical, Electronic, and Fiber Optic Parts Specification
MIL-STD-1472	Human Engineering
MIL-STD-1474	Noise Limits

### HANDBOOKS

#### DEPARTMENT OF DEFENSE

MIL-HDBK-470	Designing and Developing Maintainable Products and Systems, Volume I and Volume II
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MIL-HDBK-781	Reliability Test Methods, Plans, and Environments for Engineering Development, Qualification, and Production
MIL-HDBK-29612-1	Guidance for Acquisition of Training Data Products and Services
MIL-HDBK-29612-3	Development of Interactive Multimedia Instruction (IMI)
MIL-HDBK-29612-5	Advanced Distributed Learning (ADL) Products and Systems

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. These documents may also be downloaded from the Uniform Resource Locator (URL): <http://astimage.daps.dla.mil/online/new>).

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

ENVIRONMENTAL PROTECTION AGENCY (EPA)

40 CFR 82	Protection of Stratospheric Ozone
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(This document can be downloaded from URL: [www.epa.gov](http://www.epa.gov).)

U.S. FOOD AND DRUG ADMINISTRATION (FDA)

21 CFR 1010.2	Performance Standards for Electronic Products: General Certification
21 CFR 1040.10	Performance Standard for Light-Emitting Products: Laser Products
21 CFR 1040.11	Performance Standard for Light-Emitting Products: Specific Purpose Laser Products

(U.S. Food and Drug Administration, 5600 Fishers Lane, Rockville, MD 20857. These documents may also be downloaded from URL: [www.fda.gov](http://www.fda.gov).)

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR 1910	Occupational Safety and Health Standards
29 CFR 1910.302-308	Design Safety Standards for Electrical Systems
29 CFR 1910.21-30	Walking-Working Surfaces

(Occupational Safety and Health Administration, U.S. Department of Labor, Office of Public Affairs, Room N3647, 200 Constitution Ave., Washington DC 20210. These documents may also be downloaded from URL: [www.osha.gov](http://www.osha.gov).)

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DoD 5220.22-M	National Industrial Security Program Operating Manual (NISPOM)
DoD HLA	High Level Architecture (HLA)
OUSD Memo	DoD Joint Technical Architecture (JTA)
SCORM	Sharable Content Object Reference Model (SCORM)

(The NISPOM (DoD 5220.22-M) can be downloaded from <http://www.dss.mil>.)

(The HLA can be downloaded from <http://www.ntsc.navy.mil>.)

(The JTA can be downloaded from <http://www-jta.itsi.disa.mil>.)

(The SCORM can be downloaded from <http://www.adlnet.org>.)

2.3 Non-Government publications. The following document(s) form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY of MECHANICAL ENGINEERS (ASME)

ASME-B56.11.1	Double Race or Bi-Level Swivel and Rigid Industrial Casters (DoD Adopted)
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(Application for copies should be addressed to the American Society of Mechanical Engineers, Three Park Ave, New York, NY 10016-5990. These documents may also be downloaded from URL: [www.asme.org](http://www.asme.org).)

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI-A156.18	Materials and Finishes (i.e., Builders Hardware Manufacturers Association (BHMA)-A156.18)
ANSI-Z35.1	Accident Prevention Signs
ANSI-Z35.4	Specifications for Informational Signs Complementary to ANSI Z35.1-1972, Accident Prevention Signs
ANSI-Z53.1	Safety Color Code for Marking Physical Hazards
ANSI Z136.1	American National Standard For the Safe Use of Lasers

(Application for copies should be addressed to the American National Standards Institute 1819 L Street NW, 6<sup>th</sup> Floor, Washington DC, 20036. These documents may also be downloaded from URL: <http://web.ansi.org>.)

INSTITUTE of ELECTRICAL and ELECTRONICS ENGINEERS (IEEE)

IEEE 200	Electrical and Electronic Parts and Equipment Reference Designations for
IEEE 446	Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications
IEEE 1516.0	Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) - Framework and Rules
IEEE 1516.1	Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) - Federate Interface Specification
IEEE 1516.2	Standard for Modeling and Simulation (M&S) High Level Architecture (HLA) - Object Model Template (OMT) Specification
IEEE 12207.0	Standard for Information Technology Software Life Cycle Processes (DoD Adopted)

(Application for copies should be addressed to the Institute of Electrical and Electronics Engineers, 445 Hoes Lane, Piscataway, NJ, 08855. These documents may also be downloaded from URL: [www.ieee.org](http://www.ieee.org).)

NATIONAL FIRE PROTECTION AGENCY (NFPA)

NFPA 70	National Electric Code (DoD Adopted)
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(Application for copies should be addressed to the National Fire Protection Agency, 1 Batterymarch Park, Quincy, MA, 02269. These documents may also be downloaded from URL: [www.nfpa.org](http://www.nfpa.org).)

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA RS-471	Symbol and Label for Electrostatic Sensitive Devices (DoD Adopted)
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(Application for copies should be addressed to the Electronic Industries Alliance, 2500 Wilson Boulevard, Arlington, VA 22201-3834. These documents may also be downloaded from URL: [www.eia.org](http://www.eia.org).)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supercedes applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 Trainer functional performance requirements. Trainer functional performance requirements shall be consistent with the instructional delivery system functional characteristics as specified in MIL-PRF-29612. Trainer functional performance requirements shall facilitate learning and shall enable students to develop proficiency in performing exercises (e.g., operate, repair, service, adjust, fault isolate, troubleshoot) to meet the learning objectives. Trainers shall provide the following:

3.1.1 Realism. The trainer shall provide a realistic representation of the end item and subsystem component, controls, and mission in its specific environment to enable the student-to-trainer interaction that facilitates the mastery of the learning objectives. The following are requirements for the levels of realism:

3.1.1.1 Replication. The trainer shall duplicate the actual system or subsystem end item in its environment application.

3.1.1.2 Representation. The representation of the trainer, its systems, subsystems, and components shall depict the form, fit, and function of the end item(s) and subsystems to the precision required to facilitate the mastery of the learning objectives.

3.1.2 Cues. The trainer stimuli shall provide the student with an event, situation, condition, or signal to which the student is expected to respond.

3.1.3 Trainer stimuli performance requirements. Trainer features shall stimulate visual, tactile, olfactory, and auditory as follows:

3.1.3.1 Visual stimuli performance requirements. Trainers shall provide hardware or hardware and software features that provide visual sensory stimuli that will cue a student response to meet the learning objectives. Visual stimuli includes:

- a. Visual scale.
- b. Visual color.
- c. Visual movement.
- d. Visual texture.

3.1.3.2 Tactile stimuli performance requirements. Trainers shall provide hardware or hardware and software features that provide tactile sensory stimuli that will cue a student response to meet the learning objectives. Tactile stimuli includes:

- a. Tactile resistance.
- b. Tactile shape.
- c. Tactile size.
- d. Tactile temperature.

- e. Tactile texture.
- f. Tactile movement.

3.1.3.3 Olfactory stimuli performance requirements. Trainers shall provide hardware or hardware and software features that provide olfactory sensory stimuli that will cue a student response to meet the learning objectives. Olfactory stimuli includes:

- a. Olfactory fragrance and odor.
- b. Olfactory taste.

3.1.3.4 Auditory stimuli performance requirements. Trainers shall provide hardware or hardware and software features that provide auditory sensory stimuli that will cue a student response to meet the learning objectives. Auditory stimuli includes:

- a. Auditory duration.
- b. Auditory pitch.
- c. Auditory rate.
- d. Auditory sound and sound level.

3.1.4 Simulation. Simulations shall comply with the requirements stated in the High Level Architecture (HLA). The trainer shall perform the following simulations:

3.1.4.1 Simulation of functions and environment. The trainer shall emulate the functions and environment of the represented equipment, systems, or missions.

3.1.4.2 Simulation of normal operations and malfunctions. The systems that are part of the trainer shall be constructed to simulate normal operations and malfunctions of the represented equipment or systems.

3.1.5 Animations. The trainer visual subsystem shall provide an illusion of movement by displaying a series of successive images that appear to be continuously moving, without flicker. Animations shall be scaleable and adaptable for various applications. Animations shall comply with the requirements stated in MIL-PRF-29612 and the Sharable Content Object Reference Model (SCORM).

3.1.6 Animated electromechanical physical objects. Animated electromechanical physical objects shall be designed and constructed to:

- a. Panel type (i.e., 2-D or 3-D) trainer. Enhance the understanding of a component, system, process, or system operation.
- b. Animatronics. Provide practice to facilitate the mastery of a learning objective that requires active interaction with an animated three-dimensional model of a living thing.



- c. Mission and scenario related animations. Provide practice to facilitate the mastery of a learning objective that requires active interaction with multiple animated three-dimensional models.

3.1.7 Stimulator. The trainer shall interconnect with military organizational equipment (see 6.5.2.k) to artificially create conditions that reproduce the sensory cues encountered in the operational environment.

3.1.8 Interaction. The trainer shall provide the following types of functional interaction:

- a. Trainer controlled.
- b. Instructor controlled.
- c. Student controlled.

3.1.9 Pacing. The trainer shall pace interactions to facilitate the mastery of the learning objectives to include:

- a. Real time.
- b. Less than real time.
- c. Greater than real time.
- d. Variable time.

3.2 Trainer requirements. Trainers shall facilitate instruction related to the end item and subsystem, mission or program. Trainers as classified herein (see 1.2) shall perform as follows:

- a. Maintenance trainers. Maintenance trainers (see 6.5.2.j) shall facilitate instruction required for maintenance of the related end item and subsystems.
- b. Operator trainers. Operator trainers shall facilitate instruction related to the end item and subsystems. The trainer shall be equipped to facilitate basic and advanced training of operations, maneuvering, and navigation. The trainer system shall provide a comprehensive set of cues required to initiate emergency procedures. The trainer software shall provide scenarios that allow the student to practice the full-range of mission requirements.
- c. Training equipment. Training equipment shall include end items and subsystems (e.g., equipment groups, mock-ups, animated displays, task trainers, function trainers, other equipment) that have been constructed for training. Training equipment shall be used to facilitate instruction related to the end item and subsystems.
- d. Mission and scenario training system. The mission and scenario training system shall include trainers, training equipment, end items, systems, subsystems or components that have been constructed or modified for training. Training equipment shall be combined to support mission training exercises for individual or collective training. Additionally, software shall be utilized to collect feedback and analyze the actions of exercise participants. The trainer software shall provide scenarios that allow the student to practice the full-range of mission requirements.

3.2.1 Trainer interface. Trainers and associated software shall provide instructor-equipment and student-equipment interfaces. An intercommunications system shall permit communications between and among trainers. These interface modes are described as follows:

3.2.1.1 Instructor-equipment interface. Trainers shall be equipped with an instructor interface. The interface shall provide a planning mode for the instructor to set initial conditions, prepare exercises, and maintain the scenario database.

3.2.1.2 Student-equipment interface. Trainers shall be equipped with a student interface. The physical interface shall emulate the operation and performance of the end item and subsystems being represented. Transport delay between the student input and the resulting change that appears in the visual display shall be minimized so as to not cause motion sickness. The interface shall provide the student with a free-play (see 6.5.2.f) mode. The free-play mode shall allow the student to freeze the simulation, select malfunctions, and record, replay, and reset the free-play lesson at any time during the session. The free-play mode software shall respond to the student's input and emulate the operation and performance of the actual end item and subsystem being represented. The student-equipment interface shall provide features for the student to communicate with the instructor, to inquire about course/module completion, obtain test scores and other data.

3.2.1.3 Instructor-student interface. Complex trainers that have an instructor position and a student position shall be equipped with an instructor-student interface that facilitates intercommunications between the instructor and the student.

3.2.1.4 Trainer-trainer-military organizational equipment interface. Trainers shall be equipped to be interoperable and interface with military, federal agencies, and other suites of trainers and organizational equipment. The interface shall facilitate distributed integrated simulation, and shall interconnect constructive, virtual, and live exercises.

3.2.2 Trainer physical features. Trainer physical features shall facilitate mastery of learning objectives, related end items and subsystems, programs, and missions as follows:

3.2.2.1 Input and output signals. Trainer input and output signals shall be representative of the full range of variations encountered on the related end item and subsystems. Trainers shall be equipped so that related Support Equipment (SE) (see 6.5.2.t) can be utilized for a complete checkout of the trainer in the same manner as the SE is used on the related end item and subsystems.

3.2.2.2 Electrical power supply. Trainer electrical power supplies shall support the requirements of electrical and electronic components. Electrical systems for use outside the Continental United States (CONUS) shall be designed to operate from power sources of the host country.

3.2.2.3 Hydraulic and pneumatic power supply. Hydraulic and pneumatic power supplies shall support mechanical components of the trainer. Hydraulic and pneumatic power supplies shall duplicate the actual end item and subsystem pressures to the extent required to meet the learning objectives. The hydraulic and pneumatic systems of the trainer shall be equipped with a pressure relief system, and system emergency shutdown devices.

3.2.2.4 Fluids. Fluids used in trainers shall have characteristics representative of those used in the related end item and subsystems, with the following exceptions:

- a. The flash point shall be no lower than 200° F.
- b. Fluids shall not emit toxic fumes.
- c. The fluid shall be free of materials that support bacterial growth or have a corrosive or deteriorative effect on the materials used in construction of trainers.

3.2.2.5 Gases. For gases used in trainers, (e.g., CO<sub>2</sub>, O<sub>2</sub>, breathable air, nitrogen, tear gas) color and odor may be added for aid in identification.

3.2.2.6 Materials. Materials shall be compatible with the environment of the trainer's intended use and specified service life. Materials not specifically designated herein should be selected using guidance in MIL-HDBK-470.

3.2.2.6.1 Flammable materials. Materials shall be noncombustible or fire retardant in the most hazardous conditions of atmosphere, pressure, and temperature to be expected in their application. Nonpermanent fire retardant additives shall not be used to achieve fire retardation. Use of flammable materials shall require specific written authorization by the Government.

3.2.2.6.2 Fungus inert materials. When the specified environment is conducive to fungus growth, the equipment shall be fabricated using fungus-inert materials.

3.2.2.6.3 Hazardous materials. The trainer shall not expose personnel or the environment to excessive levels of toxic, carcinogenic, teratogenic, and otherwise hazardous materials as defined by the Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA). If hazardous materials must be used in order to meet the performance requirements of this specification, Government authorization shall be obtained, the hazardous items shall be suitably marked, and all due precautions shall be taken to prevent whatever harm the hazardous material may cause.

3.2.2.6.4 Ozone Depleting Substances (ODS). The use of substances classified as Class I and Class II ODS (see 6.5.2.o) shall be avoided unless there is no suitable non-ODS alternative available. The use of Class I ODS shall require specific authorization by the Government.

3.2.2.6.5 Metal. Metals shall be corrosion-resistant, or shall be coated or metallurgically processed to resist corrosion.

3.2.2.6.6 Wood products. Wood products shall be treated for preservation, fire-retardation, and termite protection, and shall conform to commercial Grade B or better.

3.2.2.6.7 Radioactive material. Radioactive materials shall not be utilized unless specifically authorized in writing by the Government.

3.2.2.6.8 Recycled, virgin, and reclaimed materials. Unless otherwise specified:

- a. There is no exclusion to the use of recovered materials.
- b. There is no requirement that items be manufactured from virgin materials.
- c. Reclaimed materials may be used to the maximum extent practicable.

3.2.2.6.9 Electronic transmissions. When electronic emissions produce electromagnetic interference (from conducted or radiated Radio Frequency (RF) energy) that adversely affects system functions or may cause injury to personnel, the following shall apply:

3.2.2.6.9.1 Electromagnetic Interference (EMI). EMI generated by a subsystem or other subsystems and equipment must not degrade the overall system effectiveness. Trainers shall be electromagnetically compatible among all subsystems and equipment within the system and with environments caused by electromagnetic effects external to the trainer in accordance with MIL-STD-461 and MIL-STD-464.

3.2.2.6.9.2 Electromagnetic radiation. The design shall be such that electromagnetic radiation is in accordance with MIL-STD-464.

3.2.2.6.9.3 Electrostatic Discharge (ESD). Electrical and electronic parts, assemblies, and equipment that are susceptible to damage from ESD shall be marked in accordance with the requirements stated in 3.2.2.27.20.

3.2.2.6.9.4 TEMPEST. Trainers shall not unintentionally emit compromising emanations that could disclose classified information when it is transmitted, received, handled, or otherwise processed by any information processing equipment. Security requirements for TEMPEST (see 6.5.2.u) shall comply with the requirements specified in the DoD 5220.22-M, National Industrial Security Program Operating Manual (NISPOM), Chapter 11, Section 1.

3.2.2.7 Parts. Parts shall be compatible with the environment of the trainer's intended use and specified service life. Parts shall be comprised of Commercial and Non-Developmental Items (CaNDI) (see 6.5.2.c and 6.5.2.l) to the maximum extent practicable. Trainer Peculiar Equipment (TPE) (see 6.5.2.w) shall be kept to a minimum and shall be comprised only of parts that have been authorized by the Government in accordance with the parts control program requirements of the contract. The parts control requirement shall apply to the production and provisioning of TPE.

3.2.2.8 Components. Trainers shall be equipped with actual or cost-effective substitute end item and subsystem components consistent with the training requirement.

3.2.2.8.1 Prototype and pre-production equipment. Prototype and pre-production equipment shall not be used in the construction of trainers without prior approval by the Procurement Contracting Officer (PCO).

3.2.2.8.2 Rejected and non-operable parts. The use of related end item and subsystem rejected and non-operable parts is contingent upon approval by the PCO, provided use of such parts does not create a safety hazard to personnel, adversely affect training, and does not create unique maintenance, supply and configuration requirements. For marking of rejected and non-operable parts, see 3.2.2.27.16.

3.2.2.8.3 Modification of operable system components. When it is necessary to modify operable system components (such as hydraulic pumps, pressure switches, and indicators) for trainer use, a notation to that effect shall be included in the trainer detail specification with an explanation of the changes made. For marking of modified operable system components, see 3.2.2.27.16.

3.2.2.8.4 Modification of Government Furnished Equipment (GFE). Government Furnished Equipment (GFE) (see 6.5.2.g) for trainers shall not be modified by the contractor.

3.2.2.8.5 Cutaway and plasticized components. Cutaway components (see 6.5.2.d) or plasticized components (see 6.5.2.p) shall be used when an increase in instructional value can be realized by exposing components of a system to reveal the internal mechanisms.

3.2.2.8.6 Identical units. Identical units shall represent the physical and functional characteristics of the actual end item and subsystems, components, sub-components, and parts to the precision required to support the learning objectives.

3.2.2.8.7 Special controls. Special controls required to operate the trainer that are not a part of the related end item and subsystems and are not used to control signal simulators shall be grouped in an area not visible to the students, but accessible to the instructor.

3.2.2.8.8 Attachment of components. Attachment of trainer components and subassemblies shall be in a manner that permits access to interior parts, terminals, and wiring for maintenance and repair. Components, and associated wiring, fluid lines, and tubing shall be attached in positions that do not obstruct the student's view of other components.

3.2.2.9 Sectionalized units. All exposed surfaces resulting from specified sectionalization requirements shall be free of scoring and tooling marks caused by machining operations. Additionally, exposed surfaces shall be painted with the FED-STD-595 specified red paint color number of 11120, 11105, or 11140. (These FED-STD-595 colors meet OSHA approved safety color requirements.) Additional colors may be used for contrast, to differentiate between

sectionalized mating surfaces and coloring of the interior of certain cutaway components to differentiate between pressures, components, and systems. For marking of sectionalized units, see 3.2.2.27.3.

3.2.2.10 Fasteners. Trainer fasteners used to secure removable components, casters, access doors, and other detachable items shall require a minimum number of turns to the locked position commensurate with stress requirements.

3.2.2.11 Finishes and protective coatings. Finishes and protective coatings shall be applied to all surfaces where required to reflect the actual end item and subsystem.

3.2.2.11.1 Painting, and preparation for. Surfaces to be painted shall be prepared and painted in accordance with the paint manufacturer's recommendations. Class I ODS-based solvents shall be avoided in the surface preparation process. The use of Class I ODS shall require specific authorization by the Government.

3.2.2.11.2 Nonskid surfaces. Surfaces where personnel normally step during trainer use and maintenance shall be inherently nonskid surfaces, or shall be covered with nonskid paint or material.

3.2.2.11.3 Sealing of porous structural materials. Porous structural materials shall have all surfaces and edges sealed against moisture and contamination.

3.2.2.11.4 Cleaning, painting, plating, anodized films, and chemical treatments. Cleaning, painting, plating, anodized films, and chemical treatments shall be accomplished in accordance with American National Standards Institute (ANSI)-A156.18 (i.e., Builders Hardware Manufacturers Association (BHMA)-A156.18).

3.2.2.12 Panel plumbing. Fluid lines and tubing shall be mounted on the trainer or training equipment in a manner that reflects the end item and subsystems.

3.2.2.13 Antennas, dummy loads, and absorption enclosures. If a trainer antenna is too large for installation on the trainer, a substitute shall be provided. When radiation or RF energy exists, that might interfere with established warnings, communications systems or may cause injury to personnel, the safety of personnel shall be ensured by providing dummy loads or absorption/attenuation enclosures.

3.2.2.14 Power distribution. Power distribution shall provide optimal factors for the trainer to operate in its intended instructional environment. Trainers shall contain power distribution components as follows:

- a. Power connections.
- b. Electrical power cables.
- c. Electrical power interconnection.

- d. Electrical power receptacles and connectors.
- e. Power control subassembly.
- f. Circuit protective devices.
- g. Blown fuse indicator light.
- h. Emergency power control switch.

3.2.2.14.1 Power-line monitoring/protection. The trainer shall be protected against damage and malfunctions resulting from power line abnormalities described herein. Monitors and indicators shall be provided to reveal the nature of the abnormality detected.

3.2.2.14.2 Under/overvoltage. If power line voltage at the trainer input power distribution panel exceeds the operating limits specified for the trainer by more than  $\pm$  five (5) percent for a period of five (5) seconds or more, automatic shutdown of the trainer shall occur. When the trainer is supplied by multiphase line power, automatic shutdown of the trainer shall occur when these limits are exceeded on one (1) or more of the phases. A visual indication of the condition shall be provided. If operating limits are not specified elsewhere, the limits shall be presumed to be + six (6) percent and -13 percent of the nominal power line voltage supplied.

3.2.2.14.3 Voltage transients. Phase-to-phase or phase-to-neutral voltage transients falling within the curve of figure 4 in ANSI/Institute of Electrical and Electronics Engineers (IEEE) 446-1987 shall not cause part failures, prevent resumption of normal operation, or require the equipment to recycle when the transients have ceased.

3.2.2.14.4 Phase rotation. Trainers that are supplied by multiphase line power and which have phase sensitive equipment, shall be protected against inadvertent phase-reversal conditions. A means shall be provided in the power distribution system, to prevent the energizing of phase sensitive equipment with incorrect phase sequence.

3.2.2.14.5 Under-frequency. Trainers that are expected to be powered by mobile electric power generation equipment shall be protected against under-frequency conditions. A means shall be provided to automatically initiate shutdown of the trainer, or critical equipment within the trainer, when a deviation of more than 15 percent below the nominal operating frequency occurs for a period of five (5) or more seconds.

3.2.2.14.6 Frequency transients. The trainer shall continue operation during transients within  $\pm$  three (3) percent of nominal frequency. A frequency variation of  $\pm$  15 percent for periods up to ten (10) seconds, occurring not more than once every five (5) minutes, shall not result in permanent damage, modification of characteristics, and loss or change of computer stored memory information.

3.2.2.14.7 Power interruption. The equipment shall be protected from permanent damage, modification of characteristics, and loss or change of computer stored memory information, resulting from a power interruption with power restored within one (1) to 30 seconds and occurring not more than once every five (5) minutes.

3.2.2.15 Elapsed time meters. Time meters shall be installed on each trainer, independently operable trainer subassembly (see 6.5.2.x), and subassembly group (see 6.5.2.s) to indicate the amount of time elapsed during operation of the trainer.

3.2.2.16 Malfunction control subassembly. Trainer subassemblies shall contain the switches and controls, hardware, and software that allow the instructor to select and enable simulated system malfunctions.

3.2.2.17 Wiring. Wiring for trainers, training equipment, and trainer subassemblies shall comply with National Fire Protection Agency (NFPA) 70, article 300.

3.2.2.17.1 Wire bundling. The same wire coding systems used on the related end item and subsystems shall be used on the trainer.

3.2.2.17.2 Grounding. Trainers and trainer related components shall be grounded in accordance with NFPA 70, articles 250, 300, and 501.

3.2.2.17.3 Insulation protection. Insulation protection shall be provided to protect wiring and tubing. Insulation for wiring shall comply with NFPA 70, articles 110-7, 310-2, and 400.

3.2.2.17.4 Terminal strips. Terminal strips shall be made of low-moisture absorption arc-resistant material. Terminal spacing shall be employed to prevent breakdown and low leakage resistance. Exposed terminal strips shall be provided with protective covers.

3.2.2.17.5 Live and spare conductors. Unless otherwise specified, all cables or harnesses terminating in connectors or terminal strips that contain three (3) or more live conductors, shall be provided with spare conductors as listed below. The quantity of live and spare conductors shall be determined from the total complement of parallel cables between units. The quantity of live conductors to spare conductors is shown in Table 1. (This requirement does not apply to power distribution cables.)

TABLE 1. Quantity of live conductors to spare conductors.

No. of live conductors	3 to 5	6 to 12	13 to 20	21 or more
No. of spare conductors	2	3	4	5 or 20 percent (whichever is greater)

3.2.2.17.6 Potting. Connectors shall not be potted except when required for reasons of safety, or when related end item and subsystem harnesses are used on the trainer.

3.2.2.17.7 Solderless electrical connections and soldered joints. Solderless electrical connections (wrapped) and soldered joints shall withstand the stress, jars, vibrations, and other conditions incident to use, shipping, storage, installation, and service.



3.2.2.17.8 Optical fiber cables and raceways. Optical fiber cables (see 6.5.2.n) and raceways shall be in accordance with NFPA 70, article 770. For marking of optical fiber cables, see 3.2.2.27.13.

3.2.2.18 Relays. Trainer peculiar relays shall be selected from types having long life and high reliability. Sensitive relays shall be hermetically sealed or installed in a dust-tight enclosure. Sensitive relays shall be shielded or mounted in a manner that eliminates the adverse effects of external magnetic fields.

3.2.2.19 Power supplies. The following requirements shall apply to all trainer power supplies, with the exception of power supplies that are an integral part of a CaNDI component or GFE component. Power supplies shall be in accordance with NFPA 70.

3.2.2.19.1 Output power density. The output power density of low voltage power supplies (below 1500 watts at 20 Volts Direct Current (VDC) or less) shall not be greater than two (2) watts per cubic inch.

3.2.2.19.2 Power supply derating criteria. The criteria of Table 2 shall apply to power supply parts. Power supplies shall not be operated at greater than 80 percent of rated full load capacity.

TABLE 2. Power Supply Derating Criteria.

PART TYPE	DERATING PARAMETER	DERATED TO % RATING
RESISTORS:		
Carbon Composition	Power/Voltage	50/80
Film High Stability	Power/Voltage	50/80
Wirewound Accurate	Power/Voltage	50/80
Wirewound Power	Power/Voltage	50/80
Wirewound Chassis Mounting	Power/Voltage	50/80
Variable Wirewound	Power/Voltage	50/80
Variable Non-wirewound	Power/Voltage	50/80
Thermistor	Power/Voltage	50/80
Tantalum Nitride Chip	Power/Voltage	50/80

TABLE 2. Power Supply Derating Criteria - Continued.

<b>PART TYPE</b>	<b>DERATING PARAMETER</b>	<b>DERATED TO % RATING</b>
<b>CAPACITORS:</b>		
All	Observe Ripple Voltage Rating	50
Ceramic	Voltage	50
Glass	Voltage	50
Mica	Voltage	60 dipped/ 40 molded
Film Dielectric	Voltage	50
Tantalum Solid (Special 100% current surge test required)		
Tantalum Wet (MIL-PRF-39006/22 only)	Voltage/Current	50/70
Tantalum Foil	Voltage/Current	60/70
Aluminum Electrolytic	Voltage/Current	50/70
(85 Degrees Celsius hot spot temperature)	Voltage/Current (Resin end-seal temp. protected and 99.96% alum. foil purity req.)	70/70
<b>RELAYS:</b>		
All (Use Arc Suppression)	Contact Current	50 Resistive/25
	Current Surge	80
	Coil Energize Voltage	Hold to Mfg. Normal Rating
	Coil Dropout Voltage	75 (including "Q" of mounting)
	Contact Gap	0.005 inch minimum opening
<b>SWITCHES:</b>	Contact Current/Voltage	30/50
<b>CONNECTORS:</b>	Contact Current	50
	Voltage (Dielectric Withstanding)	25
<b>MAGNETIC DEVICES:</b>	Power	50
	Current Density	
	2.0 Milliampere (ma) per circular mil	
	Current (Continuous)/(Surge)	60/90
	Voltage (Continuous)/(Surge)	60/90
	Hot Spot Temp. (Operating)	75

TABLE 2. Power Supply Derating Criteria - Continued.

<b>PART TYPE</b>	<b>DERATING PARAMETER</b>	<b>DERATED TO % RATING</b>
RF Coils	Insulation Breakdown Voltage Current	25 50
CRYSTALS:	Drive Voltage	50
TRANSISTORS: Bipolar, Power & Field Effect Transistor (FET)	Power (see note 1 and 2) Forward Current (Continuous) Voltage Transient Peak Voltage Reverse Junction Voltage Junction Temperature	50 60 75 across any junction 75 across any junction 65 across any junction (see note 3)
DIODES: Switching, General Purpose, Rectifier	Current (Surge)	70/60 (5 amp at 70%)
Zener	Power Peak Inverse Voltage Current (Surge)/(Continuous) Power	50 65 70/60 50
SCR: All	Current (Surge)/(Continuous) Peak Inverse Voltage Junction Temperature	70/70 65 (See note 3)
MICROCIRCUITS: All Linear	Combination of AC & DC load (Not Recommended) Current (Continuous)/(Surge) Voltage (Signal)/(Surge) Voltage Reverse Junction (Signal)/(Surge) Junction Temperature	  70/60 75/80 65/85  (see note 3)
Digital (see note 4)	Supply Voltage Junction Temperature Fanout	Hold to Mfg. Normal Rating (see note 3) 80

TABLE 2. Power Supply Derating Criteria - Continued.

PART TYPE	DERATING PARAMETER	DERATED TO % RATING
Note 1:	The maximum ratings as determined by the Safe Operating Area curves for power switching transistors shall not be exceeded.	
Note 2:	Power devices exhibiting "punch-through" characteristics should be derated to 50 percent on voltage parameters.	
Note 3:	Junction temperature shall not exceed plus 100 degrees centigrade. Additionally, a junction temperature rise above the part ambient temperature shall not be greater than 40 degrees centigrade and 55 degrees centigrade for devices that dissipate less than or equal to 3 watts and over 3 watts, respectively.	
Note 4:	Many families of digital microcircuits exhibit additional characteristics that may require derating (e.g., toggle frequency, hold times).	

3.2.2.20 Microelectronic and thin film devices. All microelectronic devices shall be of standard types.

3.2.2.20.1 Compatibility. Devices shall be mechanically and electrically compatible.

3.2.2.20.2 Heat dissipation. Provisions for heat dissipation shall be entirely self-contained within the trainer and shall not require external support other than ambient air at room temperature.

3.2.2.20.3 Shielding. Shielding shall protect sensitive circuits against electromagnetic interference from conducted or radiated RF energy. Shielding shall not prevent replacement of removable components.

3.2.2.20.4 Plug-in modules. Plug-in techniques shall be used to permit replacement of modular assemblies. The design of all modular assemblies shall be such that they can be inserted into the equipment in only one (1) position, with sockets oriented in the same direction and positioned so that the sockets are visible.

3.2.2.21 Hydraulic and pneumatic power hoses. Hydraulic and pneumatic connections to facility power sources shall be equipped with quick disconnect fittings and sufficient hose slack to provide for ease of maintenance. Fitting types shall be chosen for each hose to preclude errors in connections.

3.2.2.22 Simulations. Simulations shall be provided to facilitate real-time interactive training. Simulations shall be created as closely as possible to represent actual environments and situations to provide an individual or a crew with the opportunity to practice operational tasks in accordance with the training objectives. Simulations shall comply with the requirements stated in the HLA.

3.2.2.23 Animations. Animations shall be provided to enhance the understanding of a component, system, process, or operation.

3.2.2.24 Animated electromechanical physical objects. Animated electromechanical physical objects shall be as follows:

- a. Panel type (i.e., 2-D or 3-D) trainers that enhance the understanding of a component, system, process, or system operation.
- b. Animatronics that provide practice to facilitate the mastery of a learning objective that requires active interaction with an animated three-dimensional model of a living thing.
- c. Mission and scenario related animations that provide practice to facilitate the mastery of a learning objective that requires active interaction with multiple animated three-dimensional models.

3.2.2.25 Human factors engineering requirements. Trainers shall comply with the human factors engineering criteria established by MIL-STD-1472.

3.2.2.26 Lasers. Lasers (see 6.5.2.i) used in trainers or training equipment shall comply with 21 Code of Federal Regulations (CFR) 1040.10, 1040.11, and ANSI Z136.1-1999.

3.2.2.27 Data plates, identification plates and other marking. Trainer data plates, identification plates, and other marking plates shall be as specified herein. Identification plates on each trainer shall be readily visible. For trainers that are sectionalized, each component and subassembly shall be marked with an identification plate. Markings shall:

- a. Be permanent.
- b. Be securely fastened.
- c. Withstand the operational, storage, and transportation environment of the trainer.
- d. Withstand environmental testing.
- e. Withstand cleaning procedures.
- f. Be legible as required for ready readability.
- g. Be a color that is in contrast to the color of the background surface.
- h. Not adversely affect the life and utility of the item.
- i. Be of a sans-serif font such as Gothic or Arial capitals and the numerals shall be Arabic, except when Roman numerals are required for type designations.

3.2.2.27.1 Data plates. Trainer data plates shall contain the following information:

- a. Property of the U.S. Government.
- b. Military model number and nomenclature.
- c. National Stock Number (NSN).
- d. Serial number.
- e. Contract number.
- f. Manufacturer's name and address.

- g. Manufacturer's model number.
- h. Manufacturer's Commercial and Government Entity (CAGE) code.
- i. Technical manual number, if applicable.
- j. Weight.
- k. Other information as specified in the contract.

3.2.2.27.2 Identification plates for units, assemblies, subassemblies, and components. Each unit, as defined in IEEE 200-1975, shall be marked with a contractor-supplied identification (ID) plate as shown in Figure 1. The ID plates shall be located in the front and back of the units, at the top center location, and shall be installed so that they are not obscured by other parts. Information on the ID plates shall include the unit reference designator assigned in accordance with paragraph 3.2.2.27.12 below and the assembly information as shown in Figure 1. Unmodified GFE is exempt from the marking requirements of this paragraph.

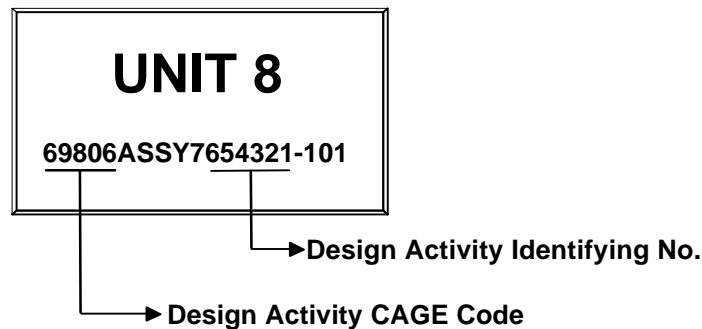


FIGURE 1. Unit ID Plate.

3.2.2.27.3 Marking of sectionalized units. The types of units listed in a. through c. below shall be marked with a contractor-supplied ID plate. The ID plate shall conform to the requirements above (see 3.2.2.27.2) except that in addition to the unit reference designator and the assembly information, the ID plate shall also include the following:

<b>PART OF TRAINER</b> _____
------------------------------

- a. Units which are part of the trainer, but are not physically or electrically attached to the trainer.
- b. Units which are part of the trainer, but are normally in storage until they are needed.
- c. Units which cannot be moved around the trainer area.

3.2.2.27.4 Marking of plug-in assemblies. Plug-in assemblies and subassemblies shall be keyed or permanently color-coded to minimize the probability of incorrect connection and insertion. Where keying or color-coding of plug-in modules is impractical, a permanent legible

directory or chart shall be posted conspicuously on or adjacent to the equipment showing identification number, location, and orientation of such modules.

3.2.2.27.5 Marking of fuse holders. The current rating of fuses shall be marked adjacent to the fuse holder. In addition, "SPARE" shall be marked adjacent to each spare fuse holder. This requirement shall apply to TPE and CaNDI that are procured using Control Drawings (CDs). Unmodified Commercial Items, GFE, and Contractor-Acquired Operational Equipment (CAOE) are exempt from the requirements of this paragraph.

3.2.2.27.6 Marking of controls and indicating devices. Markings shall be provided on the front of each exterior and interior panel, panel door, control mounting surfaces of each chassis, sub-panel, etc., to clearly designate the functions and operations of all controls, fuses, and indicating devices mounted thereon, protruding through, or available through access holes therein. All markings shall be located on the panel or chassis in correct relationship to the respective designated items. The requirements of this paragraph shall apply to TPE and CaNDI that are procured using CDs. Unmodified Commercial Items, GFE, and CAO E are exempt from the requirements of this paragraph.

3.2.2.27.7 Marking of sockets. The chassis shall be marked to identify sockets and parts, modules, or assemblies to be plugged into the sockets. The side of the chassis upon which items are plugged into sockets shall be marked, adjacent to each socket, with the reference designation for the item. The reverse side of the chassis shall be marked, adjacent to each socket, with the reference designation used in the circuit diagram and table of parts to identify the socket itself. If space does not permit marking of reference designations for sockets and parts, modules, or assemblies mounted in sockets, a location chart shall be placed where it is visible when viewing the chassis, and shall display the markings described herein. The requirements of this paragraph shall apply to TPE and CaNDI that are procured using CDs. Unmodified Commercial Items, GFE, and CAO E are exempt from the requirements of this paragraph.

3.2.2.27.8 Marking of printed wiring boards. Markings on printed wiring boards shall not interfere with electrical operation. When ink is used, it shall be non-conductive. Markings shall be considered when leakage (creepage) distances are determined. This requirement shall apply to TPE. CaNDI, unmodified GFE, and CAO E are exempt from the requirements of this paragraph.

3.2.2.27.9 Marking of terminals, terminal blocks, and strips. All terminals, terminal blocks, and terminal strips shall be identified and marked to facilitate replacement of connections. Where space limitations prohibit marking on the terminal, terminal block, or terminal strip, the marking shall be on the chassis adjacent to the terminal, terminal block, or terminal strip. The requirements of this paragraph shall apply to TPE and CaNDI that are procured using CDs. Unmodified Commercial Items, GFE, and CAO E are exempt from the requirements of this paragraph.

3.2.2.27.10 Marking of fluid and gaseous transmission lines. Fluid lines shall be marked with the type of line (e.g., Supply, Return, Drain, Vent). All pressurized lines shall also be marked with the direction of flow. Where hazardous fluids or dangerous gases are utilized or where inadvertent cross-connection of lines could result in a dangerous mixture, the name of the material conducted by the lines shall also be part of the line markings. Marking shall be on bands of material affixed with adhesive or other means which will ensure permanency of attachment for the life of the trainer without damage to the line. Location of markers shall be within one (1) foot of line connection points, oriented for readability by maintenance personnel.

3.2.2.27.11 Marking of fluid tanks and reservoirs. Fluid tanks and reservoirs shall be stenciled with capacity, contents, and the following instructions:

**MUST BE DRAINED PRIOR TO SHIPMENT**

3.2.2.27.12 Marking of reference designators. Reference designators in accordance with Section 4 of IEEE 200-1975 (Unit Numbering Method) shall be employed to identify and mark the location of electrical and electronic parts and equipment in the entire trainer. The assignment of reference designators shall begin at the unit level of assembly and shall continue down to the basic part level of assembly as defined in IEEE 200-1975. All unmodified GFE shall be identified on related system or assembly drawings and schematics with assigned unit or assembly level reference designators. Marking and location of reference designators shall be in accordance with paragraphs 8.2 and 8.2.1 of IEEE 200-1975. Method, permanency, and legibility of reference designators shall be as specified in 3.2.2.27. Cables and wires are exempt from the requirements of IEEE 200-1975, paragraphs 4.1.5.5 (Intersubassembly and Interunit Cable Connections) and 8.2.3 (Cable Assemblies); but shall be subject to the identification and marking requirements of 3.2.2.27.12.1 through 3.2.2.27.12.3.3.

3.2.2.27.12.1 Marking of cables and wires. Disconnectable cables and wires shall be marked in accordance with the following requirements, which shall apply to all equipment categories (i.e., TPE, CaNDI, GFE, and CAO). Types of disconnectables include plugs, jacks, lugged terminals, and push-on captivated wires. Jumpers or links located on terminal boards, jacks, or plugs are exempt from such marking. Soldered or wire wrap connections are also exempt from such marking. Markings shall not damage the wires or cables attached to and shall be located within approximately eight (8) centimeters from the connector, terminal or plug, oriented in such a manner as to be readable without removal of the wire or cable or support clamps.

3.2.2.27.12.2 Marking of cables. The following methods shall be used to mark cables and wires:

- a. Molded on the cable.
- b. Stamped on the cable.



- c. Securely attached, marked plastic bands (no less than .25 millimeters thickness).
- d. Bands of marked heat shrinkable tubing.

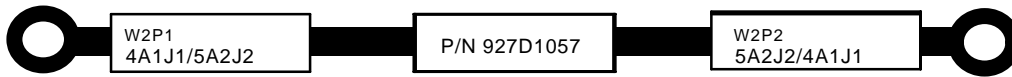
3.2.2.27.12.3 Marking of disconnectable cables. The following information shall be marked on all disconnectable cables.

3.2.2.27.12.3.1 Marking of "W" and "P" cable designations. A "W" designation (e.g., W1, W2) shall be assigned to uniquely identify cables and wires. The numerical portion of the "W" designations shall be consecutive throughout the trainer. In addition, each connector within the same cable shall be identified with a "P" designation (e.g., P1, P2). The numerical portion of the "P" designations shall be consecutive for a given cable. The "W" and "P" designations shall be marked on cables in accordance with Figure 2.

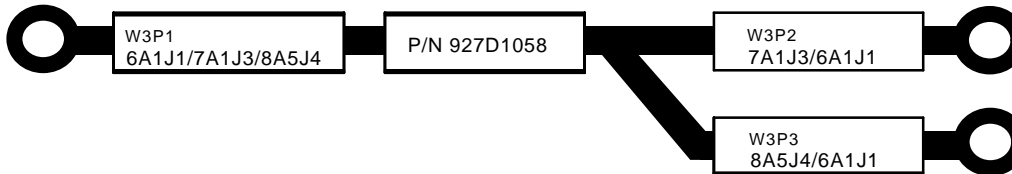
3.2.2.27.12.3.2 Marking of to-from designators. In addition to the "W" and "P" designations, cable and wire markings shall also include "to-from" reference designators to identify the locations where they are connected. Cables and wires internal to subassemblies are not required to be marked with the "from" designator. The "to-from" designators shall be marked on cables in accordance with Figure 2.

3.2.2.27.12.3.3 Marking of assembly/part number. Trainer-peculiar wires, cables, and harnesses shall also be identified and marked with the applicable assembly or part number. The number may be included with other required cable markings where space permits. Otherwise, a separate marking shall be made adjacent to the "W", "P", and "to-from" designator markings.

Basic inter-cabinet cable:



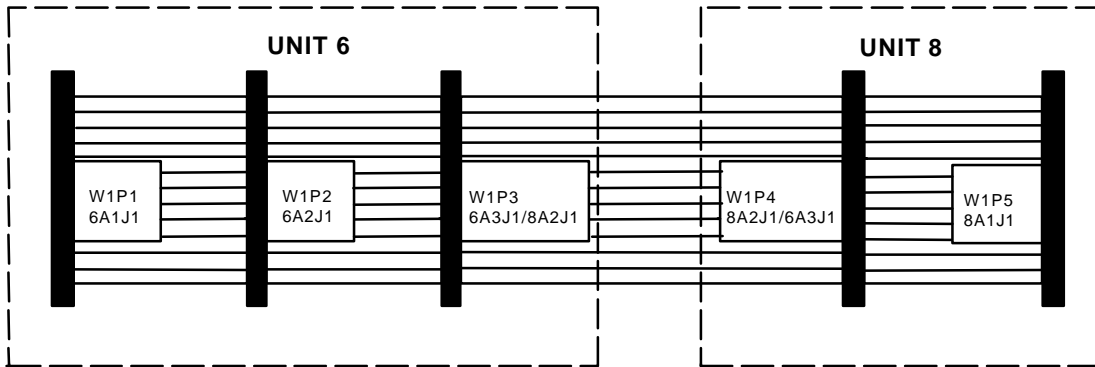
Multiple destination cable:



Terminal wire marking:



Daisy chain, continuous ribbon cable with clamp on connectors:



NOTE (1) PREFIX MAY BE OMITTED FOR WIRES OR CABLES LOCATED ENTIRELY WITHIN THE SAME CABINET.

NOTE (2) FOR PURPOSES OF THESE MARKING REQUIREMENTS, UNITS COMPRISED OF MULTIPLE CABINETS OR BAYS PERMANENTLY WELDED OR BOLTED TOGETHER SHALL BE CONSIDERED AS HAVING SEPARATE CABINETS.

NOTE (3) THE UNDERLYING CRITERIA FOR WIRE AND CABLE MARKING SHALL BE EASE OF MAINTENANCE AND REDUCTION OF CHANCES FOR MISCONNECTION.

FIGURE 2. Examples of cable markings.

3.2.2.27.13 Marking of optical fiber cables. Optical fiber cables shall be marked in accordance with NFPA 70, article 770.

3.2.2.27.14 Marking of electrical power requirements. The electrical power required to operate each trainer under specific load conditions, shall be permanently marked on a data plate.

3.2.2.27.15 Marking of trainer with modified, rejected, or non-operable parts. This marking shall appear on the trainer, and shall be prominent in appearance. When modified, rejected, and non-operable parts are used, the trainers shall be marked as follows:

**PARTS AND COMPONENTS OF THIS TRAINER WHEN INDIVIDUALLY MARKED MODIFIED, REJECTED OR NON-OPERABLE, ARE TO BE USED FOR GROUND TRAINING PURPOSES ONLY.**

3.2.2.27.16 Marking of parts that are modified, rejected, or non-operable. This marking shall appear on each such part, and shall be prominent in appearance. Marking of parts that are modified, rejected, or non-operable is as follows:

- a. Parts of military organizational equipment that have been modified for use in training shall be marked by stenciling or decals as follows:

**MODIFIED - NOT FOR OPERATIONAL USE**

- b. All rejected, non-operable, and modified parts that cannot be returned to Ready For Issue (RFI) condition, shall be individually and permanently marked by stamping or engraving as follows:

**REJECTED - NOT FOR OPERATIONAL USE**

3.2.2.27.17 Marking of safety hazards. Labels and markings shall be used to warn of specific hazards such as voltage, current, thermal, or physical. Method, permanency, and legibility of equipment safety markings shall be as specified in 3.2.2.27. Guards, barriers, access doors, covers, and plates shall be marked to indicate the hazard that may be present upon removal of such devices. When possible, marking shall be located such that it is not removed when the barrier or access door is removed. Additionally, hazards internal to units shall be marked adjacent to hazards if they are significantly different from those surrounding items. Safety hazards shall be marked as follows:

- a. Physical hazards shall be marked in accordance with ANSI-Z53.1-79.
- b. Voltage hazards shall be marked in accordance with ANSI-Z35.1-72 and ANSI-Z35.4-73.
- c. Lasers shall be marked in accordance with 21 CFR 1010.2 and 1040.10.

3.2.2.27.18 Marking of power switch warning plates. A warning plate shall be attached to the plug end of each trainer power cable and another warning plate with the same legend shall be placed adjacent to the master-keyed lock switch. The warning plate shall be labeled as follows:

**WARNING - PLACE MASTER KEYED LOCK SWITCH IN THE OFF POSITION  
BEFORE CONNECTING OR DISCONNECTING EXTERNAL POWER**

3.2.2.27.19 Marking of emergency power control switch. The emergency power control switch on each trainer and trainer subassembly shall be labeled in accordance with ANSI-Z53.1.

3.2.2.27.20 Marking of ESD assemblies. ESD sensitive assemblies shall be marked in accordance with Electronic Industries Alliance (EIA) RS-471. Unless otherwise specified herein, electrostatic discharge sensitive assemblies and equipment shall be marked as follows:

3.2.2.27.20.1 Marking of ESD sensitive assemblies. Electrostatic discharge sensitive assemblies shall be marked with either the EIA RS-471 (i.e., Figure 3) or the military symbol (i.e., Figure 4). The symbol and caution note shall be located in a position readily visible to personnel when the assembly is incorporated in its next higher assembly. When the physical size of the assembly precludes direct marking of the ESD symbol, the symbol shall be marked on an identification tag and shall be securely attached to the assembly. The ESD unit pack shall be marked as specified in MIL-STD-129. The requirements of this paragraph shall apply to TPE and CaNDI. Unmodified GFE is exempt from the requirements of this paragraph.

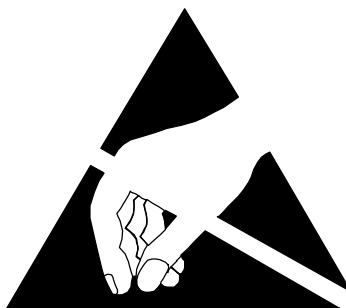


FIGURE 3. ESD symbol (EIA RS-471).

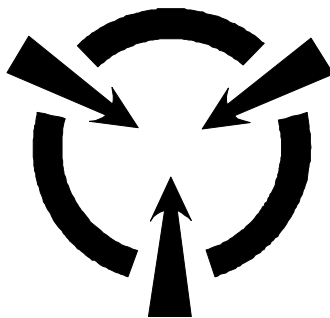


FIGURE 4. ESD symbol (Military).

3.2.2.27.20.2 Marking of ESD sensitive equipment. Equipment containing ESD sensitive parts and assemblies shall be marked with the EIA RS-471 (i.e., Figure 3) or military symbol (i.e., Figure 4). The symbol shall be located on the exterior surface of the equipment and readily visible to personnel prior to gaining access to ESD sensitive parts and assemblies within the equipment. The following ESD caution statements shall be placed adjacent to the ESD sensitive symbol:

**CAUTION  
CONTAINS PARTS AND ASSEMBLIES  
SUSCEPTIBLE TO DAMAGE BY  
ELECTROSTATIC DISCHARGE (ESD)**

3.2.2.27.20.3 Marking of external equipment terminals. The EIA RS-471 (i.e., Figure 3) or military symbol (i.e., Figure 4) and a caution note shall be applied on the exterior of the equipment cabinet adjacent to external terminals connected internally to ESD sensitive parts and assemblies.

3.2.2.27.21 Marking of security cover. On all trainers classified CONFIDENTIAL or higher, the inner fabric security cover shall be marked with the security classification in red letters not less than two (2) inches high. These letters shall appear against a white or similar high contrast background. The security classification shall not be indicated on the exterior of the outside cover.

3.2.2.27.22 Marking of hard cover. A weatherproof decal with instructions for removal and installation of the hard cover shall be placed on the cover. One (1) corner of the cover and the corresponding point on the trainer shall be marked to indicate the correct installation of the cover assembly.

3.2.2.27.23 Marking of lifting instructions for heavy trainers. Lifting instructions for heavy trainers shall be stenciled on the cover. The instructions shall include lifting points, the need for a spreader bar, and the location for insertion of forklift. Outer cover handles that are not suitable

for trainer lifting and tiedown points shall have the following legend stenciled above the handles in red letters approximately one (1) inch in height:

**WARNING - FOR COVER REMOVAL ONLY**

3.2.2.27.24 Marking center of balance. A vertical red line not less than three (3) inches long shall be stenciled on two (2) opposite sides of the trainer frame and outer cover near the bottom edge, to indicate the trainer's center of balance. The following shall be stenciled above or beside the vertical red line:

**CENTER OF BALANCE**

3.2.2.28 Safety requirements. Trainers shall provide protection for personnel during operation, repair, service, adjustment, troubleshooting, and movement. All potentially hazardous items, (e.g., high-voltage wiring, high-pressure lines, chemicals, electronics radiating RF energy, noise levels, lasers, fast acting mechanisms) shall be manufactured, installed, labeled, and marked as specified in the contract. All pyrotechnics (e.g., missile squibs, warheads, propellants) shall be inert.

3.2.2.28.1 Warning sign. A backlighted warning sign shall be centrally located on each side of a trainer used to demonstrate the operation of fast-acting mechanisms (e.g., landing gear, flight controls, control surfaces, speed brakes).

3.2.2.28.2 Warning lights. A flashing red warning light shall be provided to indicate failure of forced ventilation systems.

3.2.2.28.3 Auditory sound level. Items such as pumps, motors, and frequency converters shall be shock-mounted to minimize vibration and noise level. Noise levels shall not exceed the requirements specified in MIL-STD-1474.

3.2.2.28.4 Temperature sensing alarms. All heat producing equipment cabinets shall be equipped with temperature sensing devices, which shall be integrated into an over-temperature alarm system.

3.2.2.28.5 Equipment energized from multiple power sources. A warning label as depicted in Figure 5 shall be securely affixed to electrical and electronic units that have more than one (1) source of electrical power. The warning label shall be located in such a manner as to allow operation and maintenance personnel to identify all of the circuits providing electrical power, and the location and designation of the de-energizing switches. Method of applying, permanency, legibility, and lettering shall be as specified in 3.2.2.27.

<b>WARNING</b>		
THIS EQUIPMENT ENERGIZED FROM MULTIPLE SOURCES. TURN OFF THE FOLLOWING TO FULLY DE-ENERGIZE THIS UNIT.		
CIRCUIT	SWITCH LOCATOR	SWITCH IDENTIFICATION
_____	_____	_____
_____	_____	_____
_____	_____	_____

FIGURE 5. Multiple power source label.

3.2.2.28.6 Emergency equipment power disconnect. The trainer power distribution system shall include the power disconnects required by Occupational Safety and Health Administration (OSHA) 29 CFR 1910.302 - 308. Additional disconnects shall be provided at the instructor station(s) and student station(s). Each of the disconnecting points shall be legibly and permanently marked to indicate its purpose and operating instructions. The marking method, permanency, legibility, durability, and lettering shall be as specified in paragraph 3.2.2.27.

3.2.2.28.7 Raised surfaces. Safety requirements for stationary and mobile raised surfaces (e.g., platforms, scaffolds, ladders, stairs) shall comply with OSHA 29 CFR 1910.21-30.

3.2.2.29 Workmanship. Workmanship shall be in accordance with best industrial practices. The following requirements shall also apply.

3.2.2.29.1 Cleaning. After fabrication, parts and assembled equipment shall be clean of smudges; loose, spattered, or excess solder; weld metal; metal chips and mold release agents; or any other foreign material that might detract from the intended operation, function, or appearance of the equipment.

3.2.2.29.2 Threaded fasteners. Screws, nuts, and bolts shall show no evidence of cross threading, mutilation, or burrs, and shall be firmly secured.

3.2.2.29.3 Wiring. Wires and cables shall be positioned or protected to avoid contact with rough surfaces, irregular surfaces and sharp edges, and to avoid damage to conductors and adjacent parts. The containment means (e.g., lacing, ties, tiedown straps) for harnesses and cables shall be neat in appearance, uniformly applied, and positioned to retain critical form factors and breakout locations. The containment means shall not cause the insulation to deform to the point where performance is adversely affected. There shall be no evidence of burns,

abrading, or pinch marks in the insulation that could cause short circuits or leakage. Sufficient clearance shall be provided between wires or cables and heat generating parts to avoid deterioration of the wires and cables.

3.2.2.29.4 Shielding on wires and cables. Shielding on wires and cables shall be secured in a manner that will prevent it from contacting or shorting exposed current-carrying parts. The ends of the shielding or braid shall be secured to prevent fraying.

3.2.2.30 Modifications, changes, and configuration control. Modifications and changes induced by platform trainer improvements and safety requirements shall be incorporated in the trainers and related components in accordance with the approved Configuration Management Plan.

3.2.2.31 Structural integrity. The type of material for trainer frames shall be the shape, size, and structural integrity required to safely support the trainer components and personnel when used in its intended environment. Each trainer shall be constructed so that parts will not work loose in service. Trainers shall be built to withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service.

3.2.2.31.1 Welded joints. Welded joints shall withstand the stress, jars, vibrations, and other conditions incident to use, shipping, storage, installation, and service.

3.3 Availability (see 6.5.2.a) requirements. Operational Availability ( $A_o$ ) (see 6.5.2.m) and Inherent Availability ( $A_i$ ) (see 6.5.2.h) requirements are as follows:

3.3.1 Operational Availability ( $A_o$ ) requirements. The trainer  $A_o$  factor for scheduled operation in the training environment shall be 95 percent using the formula in Figure 6.

$A_o = \frac{\text{Up Time}}{\text{Up Time} + \text{Down Time}} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR} + \text{MLDT}}$	
<b>Legend:</b> $A_o$ = Operational Availability MTBF = Mean Time Between Failure MTTR = Mean Time To Repair MLDT = Mean Logistics Down Time (mean time for repair part procurement)	

FIGURE 6. Operational Availability ( $A_o$ ) formula.

3.3.2 Inherent Availability ( $A_i$ ) requirements. The trainer  $A_i$  factor shall be as specified in the contract using the formula in Figure 7.



$A_i = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$
<p><b>Legend:</b></p> <p><math>A_i</math> = Inherent Availability</p> <p>MTBF = Mean Time Between Failure</p> <p>MTTR = Mean Time To Repair</p>

FIGURE 7. Inherent Availability ( $A_i$ ) formula.

3.4 Reliability requirements. Reliability requirements shall be in accordance with MIL-STD-790. MIL-HDBK-781 should be used for guidance for reliability. Reliability requirements shall be as follows:

- a. The minimum MTBF for the trainer including GFE and CaNDI shall not be less than 140 hours.
- b. The trainer shall operate 16 hours a day, five (5) days a week, 50 weeks a year for an operating life of 15 years, but shall be capable of operating 20 hours a day, seven (7) days a week, and 52 weeks a year without a major overhaul.
- c. Power supply reliability shall be rated by the manufacturer at no less than 80,000 hours MTBF. Power supplies that are an integral part of GFE, and CaNDI are exempt from this requirement.

3.5 Maintainability requirements. MIL-HDBK-470 provides guidance for maintainability. Quantitative maintainability requirements for the trainer systems, shall be as follows:

- a. MTTR shall not be greater than 0.5 hours.
- b. The Maximum Corrective Maintenance Time (MCMT) shall not be greater than 1.0 hour for unscheduled in-site corrective maintenance.
- c. The Mean Preventative Maintenance Time (MPMT) shall not be greater than 1.5 hours per day.
- d. In determining the trainer maintainability GFE and CaNDI shall be included in the calculations of the MTTR.
- e. MCMT shall be defined as the time required for corrective maintenance, excluding administrative time. Administrative time shall include such items as test equipment assembly time, equipment not-under-repair warm-up time, travel time to and from the job, reference material acquisition time, training time, quality inspection time, and workload control time. The MTTR and MCMT requirements shall apply to on-system analysis and diagnostics.

3.5.1 Accessibility. Accessibility characteristics shall be in accordance with the following subparagraphs:

3.5.1.1 Assemblies. Channel-guided sections with tracks, rollers, pivots, or a combination thereof shall be used for providing accessibility to units, assemblies, subassemblies, and parts. Automatically operated locking devices shall be provided to lock the chassis in the servicing position as well as in the fully operated and fully closed positions. Each major assembly, subassembly, and unit of the training device, shall permit access to its interior components and parts for maintenance. Where visual inspection is necessary and open access is not feasible, transparent access panels shall be used.

3.5.1.2 Replacement of module assemblies. Plug-in techniques shall be used to permit replacement of modular assemblies. All modular assemblies shall be constructed so that they can be inserted into the equipment in one (1) position only. Sockets shall be oriented in the same direction and positioned so that the sockets are visible. Modular circuits shall be grouped in functional units.

3.5.1.3 Wiring board extender cards. Where connector termination points are not accessible for testing, extender cards shall be provided. Extender cards shall have a matching indexing system and shall be identified with the corresponding wiring boards.

3.5.1.4 Covers, panels, and doors. Front panels that contain parts requiring maintenance such as instruments, switches, and potentiometers shall be hinged. Where parts and assemblies are mounted on hinged doors, panels, and covers, a separate grounding means shall be provided for the electrical ground return. Panels shall have locking devices that permit the panel to be maintained in an open position to provide full accessibility to all parts.

3.5.1.5 Removal, replacement, and movement of component parts. Component parts shall be configured to facilitate removal, replacement, and movement without injury to personnel or damage to equipment.

3.5.1.6 Replacement of parts and microelectronic functional devices. Electromechanical assemblies, modular parts, and subassemblies shall be mounted to permit removal and decoupling from the mechanical portion of the assembly.

3.5.1.7 Lamps. All lamps used in the trainer shall be easily accessible for replacement.

3.5.1.8 Cable slack. Cable slack and cable bending features shall be provided to ensure full extension access to multiple equipment extensions during maintenance without stressing the cables and associated connectors. Cable slack shall also be provided in the cables behind equipment panels to permit removal of each instrument, display, or control panel and disconnection from associated cables in one (1) maintenance operation from the front of the equipment without stressing the cables and associated connectors.

3.6 Special tools. Special tools shall be required only when common tools are inadequate. Special tools developed for servicing the trainer shall be provided concurrently with delivery of the trainer. Special tools shall be retained in holders provided inside the equipment near where

the tool(s) is normally used. Contractor furnished tools required for maintenance or adjustment of the component on any subassembly shall be furnished with each trainer.

3.7 Trainer Computer System (TCS) requirements. The TCS consists of the trainer computer system, the Trainer Computer System Software (TCSS) (see 6.5.2.y), and the computer network required for a trainer system. The following portions of the TCS shall be Commercial Items: computers, peripherals, mass storage devices, diagnostic programs for the items already listed, and operating system software. The remainder of the TCS shall consist of CaNDI whenever practicable. Specific hardware and software requirements for the TCS shall be as follows:

3.7.1 TCS instructor and student station hardware requirements. The hardware for the TCS instructor station(s) and student station(s) shall include:

- a. Processor.
- b. Operating System.
- c. Disk drives.
- d. Storage devices.
- e. Input/output devices.
- f. Network capability.
- g. Peripherals.

3.7.1.1 TCS peripheral compatibility. Peripherals shall perform in accordance with recognized and approved industry standards.

3.7.1.2 Removable storage media for classified information. Classified information shall be stored on removable storage media of a physical size to allow securing the stored information (either the storage media unit or the complete unit) in a classified material storage drawer 10 1/4 inches high by 15 15/16 inches wide by 24 3/4 inches deep or less. Removal for storage shall require five (5) minutes or less.

3.7.1.3 Processing resource and reserve capacity. The computer system shall provide processing resource and reserve capacity to meet the performance requirements. Spare resources shall be provided to allow for expansion and modification. The spare processing requirements are as follows:

3.7.1.3.1 Spare main memory. At least 50 percent of the capacity of installed main memory shall remain unutilized during worst-case trainer operations. At least 50 percent of the capacity of installed shared memory shall remain unutilized during worst-case trainer operations. At least 50 percent of the capacity of installed reflective memory shall remain unutilized during worst-case trainer operations. Installed memory shall be directly accessible by one (1) or more processors.

3.7.1.3.2 Spare mass storage. At least 50 percent of the formatted capacity of each mass storage device shall remain unutilized during worst-case trainer operations.

3.7.1.3.3 Spare processing capacity. At least 50 percent of the processing capacity of each Central Processing Unit (CPU) shall be unused during worst-case trainer operations, except for processors embedded in Commercial Item products not used for hosting other computer programs (i.e., beyond those integral to the Commercial Item product). Trainer functionality shall remain satisfactory when CPU processing time utilization is limited to 50 percent of available time.

3.7.1.3.3.1 Synchronous real-time functions. For synchronous real time systems, spare processing time in each period of time, corresponding to the highest iteration rate being used, shall be provided for each processor. This spare processing time shall be not less than 50 percent of the available processing time in that period (e.g., for a 30 Hz iteration rate, the period of time is 33.33 milliseconds, and the spare provided in each period shall be at least 16.67 milliseconds). A means shall be provided to determine and report the amount of spare processing time available for each time slot. Spare time requirements for synchronous real-time functions and non-synchronous functions shall be met concurrently.

3.7.1.3.3.2 Non-synchronous functions. Non-synchronous functions shall perform in accordance with the requirements of this specification while 50 percent of the processing time is temporarily locked out. A means shall be provided to allow operator selection of the percent of the processor time to be locked out. The lockout periods shall be uniformly distributed.

3.7.1.3.4 Spare input/output capacity. For each type of channel for each separate interface, the spare input/output channel capacity shall be no less than 20 percent of the installed input/output channel capacity. The spare interface channels shall include analog-to-digital, digital-to-analog, digital-to-digital, discrete interface devices, and serial and parallel computer interface ports.

3.7.2 Trainer Computer System Software requirements. The TCSS is the totality of software (i.e., programs, firmware, micro programs, and databases) associated with a trainer system. TCSS software utilized for all trainers shall be common wherever possible and shall be as follows:

- a. Software and firmware development and documentation shall be in accordance with IEEE 12207.0.
- b. The source language for programming all real-time software shall be in accordance with IEEE 12207.0. All machine dependent code shall be logically grouped, packaged, and provided with a meaningful package name. Similarly, all compiler dependent code shall be contained in its own package and include a meaningful package name.
- c. The performance of the compiler shall support system operational reserve capacities as specified in the contract.

- d. Provisions shall be included in the real-time software to detect mathematical and operational errors.
- e. The real-time executable load shall detect overflow and division by zero cases.

3.7.2.1 Trainer system firmware. Firmware shall provide computer programs and data stored in a class of non-destructive memory that cannot be dynamically modified by the computer processing programs. A complete source code listing for all non-CaNDI firmware shall be provided to the procuring activity.

3.7.2.2 TCSS retention. All TCSS shall be delivered with, and considered an integral part of the trainer.

3.7.2.3 Trainer computer software. The trainer manufacturer shall not modify computer programs obtained from the computer vendor or a commercial software vendor. Programs provided with the trainer shall include:

3.7.2.3.1 Real-time simulation, control, and processing programs. The real-time simulation, control, and processing programs shall be organized in a modular object oriented manner, and shall execute at rates that will ensure computational stability and realistic dynamic responses.

3.7.2.3.2 Utility programs. Computer system utility programs to be provided shall include:

- a. Assemblers.
- b. Loaders with linking options.
- c. Data conversion routines.
- d. Memory dump routines.
- e. Input/output routines for the specified peripheral equipment.
- f. Disk handlers.
- g. Math and scientific routines.
- h. File editor.
- i. Data format conversion routine.
- j. Validated compiler and All Program Support Environment (APSE) tools required for life cycle support of the developed TCSS.
- k. Other utility software as specified in the contract.

3.7.2.3.3 Maintenance and test programs. Maintenance and test programs shall be provided to test the operation of the computers, peripheral equipment, and the trainer's simulation equipment. These programs shall include the following:

- a. System readiness check program. Daily readiness check programs shall enable operating personnel to determine that the trainer is ready for operation. Provisions shall be made for the automatic sequencing through the daily readiness check program, or portions thereof, to verify the desired output at each step. The operator shall have the option of either proceeding, after noting the discrepancies, or stopping the execution. Identification

of errors shall be displayed. The system daily readiness check shall require less than 30 minutes to complete.

- b. Real-time interface equipment diagnostic program. An on-line diagnostic program shall test the interface equipment for intolerance operation. The program shall run automatically with a minimum of operator effort.
- c. Discrete input/discrete output check program. A program(s) shall be provided to check for closed-loop functioning of the discrete input and discrete output channels.
- d. Analog input/analog output check program. A program(s) shall be provided to test all analog channels and devices through their full range of operation, as a closed-loop calibration test. All channels not functioning within specified limits shall be indicated by hardcopy printout. Input periodicity variations and amplitude variation, as well as test precision and accuracy limits, shall be controllable by operator input.
- e. Resource utilization measurement program. The resource utilization measurement program shall identify the percentage of the utilization of the CPU, memory, data storage, and input/output channel capacity.
- f. The maintenance and test program(s) shall generate a hardcopy printout of results.
- g. Other maintenance and test programs as specified in the contract.

3.7.2.3.4 Computer diagnostic programs. Commercially available diagnostic programs for the selected computer shall be provided. The diagnostic programs shall verify the correct operation of the arithmetic unit(s), control unit(s), input/output unit(s), memory unit(s), and peripheral devices.

3.7.2.3.5 Operating system software. The operating system shall provide run-time environment functions needed for system operation and life cycle support. The operating system shall be Commercial Item software.

3.7.2.3.6 Cycle time measurement programs. Programs to determine the time actually required to execute the operational programs shall be provided.

3.7.2.3.7 TCSS source code. Complete source code listings for all non off-the-shelf software shall be provided to the procuring activity. All input/output parameters and locations for the subject TCSS shall be clearly defined. The media and labeling (indexing) system used for subject listings shall be approved by the procuring activity.

3.7.2.3.8 Software configuration control tool. An automated software configuration control tool shall be provided to manage the software baseline of the trainer and of the TCSS. The tool shall store and control the software configuration database applicable to all software regardless of the target architecture. The tool shall accommodate multiple versions of baseline software at various levels of approval for both the trainer and the TCSS. The tool shall:

- a. Track changes to machine-readable information such as source code, data files, link-ready object code, binary data files, executable code (tasks), and documentation.
- b. Label and record configuration items.

- c. Produce data in American Standard Code for Information Interchange (ASCII) format.
- d. Track dependencies among combinations of configuration items.
- e. Maintain a complete change history, including archiving and retrieving of original baseline and subsequent versions.
- f. Reconstruct previous versions on demand.
- g. Document, annotate, track, and control changes to configuration items.
- h. Track multiple trainer configurations and multiple adaptations of each trainer.
- i. Ensure conformance with appropriate standards for the highest level of classified information in the trainer and in the TCSS.
- j. Provide automated audit reports.
- k. Track change activity including assignment, development, test, accept/reject, hold, and deassignment.
- l. Control access via passwords.
- m. Limit access of various users to specific types of features and capabilities by some combination of user name and password.
- n. Track released configurations through the life cycle.
- o. Create new working configurations from previously approved configurations.
- p. Control the generating of executable code and processed data files from configured items.
- q. Assign configuration identifiers to new configuration items.
- r. Rebuild previously existing configuration items without requiring a new configuration revision level to be used.

3.7.2.3.9 Generating executable code and data files. Except for commercial item software, the TCSS shall generate compiled executable code used on the trainer and TCSS from deliverable source code. Except for commercial item software, the TCSS shall generate processed data files used on the trainer from deliverable raw data files (e.g., data files in ASCII form).

3.7.2.3.10 Interactive creation and change. The TCSS shall provide for interactive creation of, and interactive change of, source code, raw data files, and other files.

3.7.3 TCS network. If a network is provided as part of the TCS, it shall have the following performance characteristics:

- a. Network protocols that conform to recognized industry standards.
- b. Record level protection to be provided for shared files.
- c. Analysis tools to be provided for determination of:
  - (1) Network faults.
  - (2) Packet losses.
  - (3) Bit error rate.
  - (4) Peak and average network loading. Peak rates shall be determined for sample periods less than or equal to one (1) second.

- (5) Packet contents and headers at Open System Interconnection (OSI) layers two (2) through four (4).
- d. The network shall sustain the removal and addition of nodes without adversely affecting communications among the remaining nodes of the network. If a node incurs an error condition, the error condition shall not adversely affect the operation of the network.
- e. Peak network utilization (when the sample period is less than or equal to one (1) second) not exceeding 50 percent of capacity.
- f. High level language support.
- g. Support the bi-directional transfer of files and messages among nodes.

3.8 Overlying architectures. The trainer, its hardware, simulations, and software shall comply with the requirements stated in the JTA and HLA. The following requirements apply:

3.8.1 High Level Architecture. An individual simulation or set of simulations created for one purpose shall be developed so that they can be applied to another application in accordance with the requirements in the HLA. Simulation software shall comply with the HLA rules, the HLA interface specification, and the HLA object model template as described in IEEE 1516-2000, IEEE 1516.1-2000, and IEEE 1516.2-2000. Refer to MIL-HDBK-29612-5 for guidance regarding the HLA.

3.8.2 Joint Technical Architecture (JTA). Trainers must comply with the DoD's technical architecture requirements in the JTA to provide a foundation for interoperability among all tactical, strategic, and sustaining base systems. Refer to MIL-HDBK-29612-5 for guidance regarding the JTA.

3.9 Advanced Distributed Learning (ADL). ADL products shall comply with the SCORM. MIL-HDBK-29612-5 should be used for guidance for all trainers selected to fulfill the ADL initiative.

3.10 Interactive Multimedia Instruction (IMI) material. IMI shall provide instructional material that comprises part of the training equipment used to facilitate mastery of learning objectives being taught with a trainer. IMI shall consist of the following: animations, Interactive Courseware (ICW), electronic testing, electronic management tools, electronic publications, and other products as specified in MIL-PRF-29612. MIL-HDBK-29612-1 and -3 should be used as guidance.

3.11 Trainer accessory requirements. The trainer accessory requirements specified and defined herein are of a general nature, detailed requirements shall be as specified in the contract. The trainer accessories include:

3.11.1 Casters. All trainers and subassemblies weighing in excess of 75 pounds in transportation configuration shall be equipped with casters in accordance with American Society of Mechanical Engineers (ASME)-B56.11.1.



3.11.2 Screw jacks. Screw jacks shall be provided in accordance with ASME-B56.11.1.

3.11.3 Forklift slots. Each trainer and subassembly weighing in excess of 75 pounds shall contain forklift slots for transportation purposes.

3.11.4 Drip pans. Detachable drip pans with readily accessible low-point drain valves shall be located under all liquid systems.

3.11.5 Covers. Covers shall be provided for each individual trainer as follows:

3.11.5.1 Waterproof soft covers. Waterproof soft covers shall be provided for protection against weather damage during shipment. These covers shall be fabricated of a coated waterproof fabric or equivalent and shall fit over individual trainers in the shipping configuration. All corners and points of stress shall be reinforced to ensure maximum strength and durability. Covers shall be fitted with waterproof zippers where required to permit ease of installation and removal. Fasteners shall be provided, where required, to ensure a reasonably tight fit and secure cover. Fasteners provided for this cover shall be of a type that can be secured or unsecured quickly with no special tools.

3.11.5.2 Waterproof hard covers. Hard covers shall be provided for protection against weather and handling damage during shipment.

3.11.5.3 Dust covers. Dust covers shall be provided for each trainer requiring protection against damage due to the collection of dust during periods of non-use. These covers shall be fabricated of a lightweight fabric material and shall fit the individual trainer in both the shipping and operating configuration. Corners and points of stress shall be reinforced to ensure maximum strength and durability. Covers shall be fitted with zippers, where required, to permit ease of installation and removal. Fasteners shall be provided, where required, to secure the cover to the trainer.

3.11.5.4 Security covers. Covers shall be provided for all trainers classified CONFIDENTIAL or higher, to protect the classification of the trainer. The security cover shall be marked in accordance with the marking requirements in paragraph 3.2.2.27.21.

3.12 Environmental conditions. All trainers shall withstand operation in its intended environment and transportation and storage environments without deterioration. The trainer shall withstand the environmental conditions shown in Table 3.

TABLE 3. Environment conditions and requirements.

ENVIRONMENT	CONDITION	REQUIREMENT
Training	Temperature range	65° F to 90° F
	Humidity range	Non-condensing
	Altitude	Sea level to one (1) mile above sea level
Transportation and Storage (See note)	Temperature range	As specified in the contract
	Humidity range	Non-condensing
	Altitude	Sea level to 30,000 feet altitude
Note: Transportation environments include conditions such as vibration, dust, acceleration, acoustical noise, and shock, encountered in transportation by aircraft, trucks, sea-craft, and movement by forklift.		

3.13 Transportability and storage. Trainers shall withstand transportability and storage requirements as specified in the contract. (Modes of transportation include air, truck, rail, and ship.) Trainers shall withstand the strains, jars, vibrations, and other conditions incident to shipping, storage, installation, and service.

3.13.1 Assembly and disassembly for shipment. Trainers shall be constructed to allow for partial disassembly when size, weight, and cost limitations are a factor in shipment.

3.13.2 Marking for shipment and storage. All trainers shall be marked for shipment and storage in accordance with MIL-STD-129.

#### 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.2).
- b. Quality conformance inspection (see 4.3).

4.2 First article inspection. Unless otherwise specified, the first article inspection shall occur at the contractor's facility. The contractor shall demonstrate that the trainer or training equipment supports all required training objectives and must pass the tests and inspections, as specified herein, before preliminary acceptance. Failure of the first article trainer or training equipment to meet the requirements or pass the in-plant tests and inspections, as specified herein, shall be cause for rejection.

4.3 Conformance inspection. The first article on-site inspection tests shall be conducted at the Government training facility after a satisfactory in-plant inspection. The on-site conformance inspection shall include the examination of all tests described in 4.4 through 4.5.9.34.

4.4 Examination. Trainers shall be examined for compliance with the requirements specified in 3.1 through 3.13. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following a failure to meet the specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one (1) or more defects preventing or lessening maximum efficiency shall constitute cause for rejection. Table 4 provides a cross-reference from Section 3 requirements to the applicable Section 4 verification requirement.

TABLE 4. Requirements to verification cross-reference.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.1	Trainer functional performance requirements	4.5.1	Trainer functional performance test
3.1.1	Realism	4.5.1	Trainer functional performance test
3.1.1.1	Replication	4.5.1	Trainer functional performance test
3.1.1.2	Representation	4.5.1	Trainer functional performance test
3.1.2	Cues	4.5.1	Trainer functional performance test
3.1.3	Trainer stimuli performance requirements	4.5.1	Trainer functional performance test
3.1.3.1	Visual stimuli performance requirements	4.5.1	Trainer functional performance test
3.1.3.2	Tactile stimuli performance requirements	4.5.1	Trainer functional performance test
3.1.3.3	Olfactory stimuli performance requirements	4.5.1	Trainer functional performance test
3.1.3.4	Auditory stimuli performance requirements	4.5.1	Trainer functional performance test
3.1.4	Simulation	4.5.2	Simulation test
3.1.4.1	Simulation of functions and environment	4.5.2	Simulation test
3.1.4.2	Simulation of normal operations and malfunctions	4.5.2	Simulation test
3.1.5	Animations	4.5.3	Animations test
3.1.6	Animated electromechanical physical objects	4.5.4	Animated electromechanical physical objects tests
3.1.7	Stimulator	4.5.5	Stimulator test
3.1.8	Interaction	4.5.6	Interaction and pacing test
3.1.9	Pacing	4.5.6	Interaction and pacing test

TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.2	Trainer requirements	4.4.1.q 4.4.1.r 4.5.7 4.5.8 4.5.9 4.5.9.1 4.5.9.2 4.5.9.3 4.5.9.4 4.5.9.5 4.5.9.6	Visual examinations Visual examinations Trainer tests Trainer interface test Operational tests Software cold start test Trainee station tests Instructor/student station tests Visual system tests Motion system tests Visual-motion synchronization test
3.2.a	Maintenance trainers	4.5.7.1	Maintenance trainer test
3.2.b	Operator trainers	4.5.7.2	Operator trainer test
3.2.c	Training equipment	4.5.7.3	Training equipment test
3.2.d	Mission and scenario training system	4.5.7.4	Mission and scenario training system test
3.2.1	Trainer interface	4.5.8	Trainer interface test
3.2.1.1	Instructor-equipment interface	4.5.8.1	Instructor-equipment interface test
3.2.1.2	Student-equipment interface	4.5.8.2 4.5.9.6	Student-equipment interface test Visual-motion synchronization test
3.2.1.3	Instructor-student interface	4.5.8.3	Instructor-student interface test
3.2.1.4	Trainer-trainer-military organizational equipment interface	4.5.8.4	Trainer-trainer-military organizational equipment interface test
3.2.2	Trainer physical features	4.5.9	Operational tests
3.2.2.1	Input and output signals	4.5.9.3	Instructor/student station tests
3.2.2.2	Electrical power supply	4.5.9.7	Electrical tests
3.2.2.3	Hydraulic and pneumatic power supply	4.5.9.8	Hydraulic and pneumatic power supply tests
3.2.2.4	Fluids	4.4.1.a	Visual examinations
3.2.2.5	Gases	4.4.1.a	Visual examinations
3.2.2.6	Materials	4.4.1.b	Visual examinations
3.2.2.6.1	Flammable materials	4.4.1.b	Visual examinations
3.2.2.6.2	Fungus inert materials	4.4.1.b	Visual examinations
3.2.2.6.3	Hazardous materials	4.4.1.b	Visual examinations
3.2.2.6.4	Ozone Depleting Substances (ODS)	4.4.1.b	Visual examinations
3.2.2.6.5	Metal	4.4.1.b	Visual examinations
3.2.2.6.6	Wood products	4.4.1.b	Visual examinations
3.2.2.6.7	Radioactive material	4.4.1.b	Visual examinations
3.2.2.6.8	Recycled, virgin, and reclaimed materials	4.4.1.b	Visual examinations

TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.2.2.6.9	Electronic transmissions	4.5.9.9	Electronic transmissions test
3.2.2.6.9.1	Electromagnetic Interference (EMI)	4.5.9.9.1 4.5.9.17.e	EMI test Microelectronic and thin film devices test
3.2.2.6.9.2	Electromagnetic radiation	4.5.9.9.2	Electromagnetic radiation test
3.2.2.6.9.3	Electrostatic Discharge (ESD)	4.5.9.9.3	ESD test
3.2.2.6.9.4	TEMPEST	4.5.9.9.4	TEMPEST test
3.2.2.7	Parts	4.4.1.c	Visual examinations
3.2.2.8	Components	4.4.1.d	Visual examinations
3.2.2.8.1	Prototype and pre-production equipment	4.4.1.d	Visual examinations
3.2.2.8.2	Rejected and non-operable parts	4.4.1.d	Visual examinations
3.2.2.8.3	Modification of operable system components	4.4.1.d	Visual examinations
3.2.2.8.4	Modification of Government Furnished Equipment (GFE)	4.4.1.d	Visual examinations
3.2.2.8.5	Cutaway and plasticized components	4.4.1.d	Visual examinations
3.2.2.8.6	Identical units	4.4.1.d	Visual examinations
3.2.2.8.7	Special controls	4.4.1.d	Visual examinations
3.2.2.8.8	Attachment of components	4.4.1.d	Visual examinations
3.2.2.9	Sectionalized units	4.4.1.e 4.4.1.t	Visual examinations Visual examinations
3.2.2.10	Fasteners	4.4.1.f	Visual examinations
3.2.2.11	Finishes and protective coatings	4.4.1.g	Visual examinations
3.2.2.11.1	Painting, and preparation for	4.4.1.g	Visual examinations
3.2.2.11.2	Nonskid surfaces	4.4.1.g	Visual examinations
3.2.2.11.3	Sealing of porous structural materials	4.4.1.g	Visual examinations
3.2.2.11.4	Cleaning, painting, plating, anodized films, and chemical treatments	4.4.1.g	Visual examinations
3.2.2.12	Panel plumbing	4.4.1.h	Visual examinations
3.2.2.13	Antennas, dummy loads, and absorption enclosures	4.4.1.i	Visual examinations
3.2.2.14 a-h	Power distribution	4.5.9.10.a	Power distribution tests
3.2.2.14.1	Power-line monitoring/protection	4.5.9.10.b	Power distribution tests
3.2.2.14.2	Under/overvoltage	4.5.9.10.c	Power distribution tests
3.2.2.14.3	Voltage transients	4.5.9.10.d	Power distribution tests

TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.2.2.14.4	Phase rotation	4.5.9.10.e	Power distribution tests
3.2.2.14.5	Under-frequency	4.5.9.10.f	Power distribution tests
3.2.2.14.6	Frequency transients	4.5.9.10.g	Power distribution tests
3.2.2.14.7	Power interruption	4.5.9.10.h	Power distribution tests
3.2.2.15	Elapsed time meters	4.5.9.11	Elapsed time meter test
3.2.2.16	Malfunction control subassembly	4.5.9.12 4.5.9.12.1	Malfunction control subassembly test Malfunction tests
3.2.2.17	Wiring	4.5.9.13	Wiring and grounding systems test
3.2.2.17.1	Wire bundling	4.5.9.13	Wiring and grounding systems test
3.2.2.17.2	Grounding	4.5.9.13	Wiring and grounding systems test
3.2.2.17.3	Insulation protection	4.5.9.13	Wiring and grounding systems test
3.2.2.17.4	Terminal strips	4.5.9.13	Wiring and grounding systems test
3.2.2.17.5	Live and spare conductors	4.5.9.13	Wiring and grounding systems test
3.2.2.17.6	Potting	4.5.9.13	Wiring and grounding systems test
3.2.2.17.7	Solderless electrical connections and soldered joints	4.5.9.13	Wiring and grounding systems test
3.2.2.17.8	Optical fiber cables and raceways	4.5.9.14	Optical fiber cables and raceways test
3.2.2.18	Relays	4.5.9.15	Relay tests
3.2.2.19	Power supplies	4.5.9.16	Power supplies test
3.2.2.19.1	Output power density	4.5.9.16	Power supplies test
3.2.2.19.2	Power supply derating criteria	4.5.9.16	Power supplies test
3.2.2.20	Microelectronic and thin film devices	4.5.9.17.a	Microelectronic and thin film devices test
3.2.2.20.1	Compatibility	4.5.9.17.b	Microelectronic and thin film devices test
3.2.2.20.2	Heat dissipation	4.5.9.17.c	Microelectronic and thin film devices test
3.2.2.20.3	Shielding	4.5.9.17.d 4.5.9.17.e	Microelectronic and thin film devices test Microelectronic and thin film devices test
3.2.2.20.4	Plug-in modules	4.5.9.17.f	Microelectronic and thin film devices test
3.2.2.21	Hydraulic and pneumatic power hoses	4.5.9.18	Hydraulic and pneumatic power hose test
3.2.2.22	Simulations	4.5.2	Simulation test
3.2.2.23	Animations	4.5.3	Animations test
3.2.2.24	Animated electromechanical physical objects	4.5.4	Animated electromechanical physical objects tests
3.2.2.25	Human factors engineering requirements	4.5.9.19	Human factors engineering compliance tests
3.2.2.26	Lasers	4.5.9.20	Laser tests

TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.2.2.27	Data plates, identification plates and other marking	4.4.1.j	Visual examinations
3.2.2.27.1	Data plates	4.4.1.j	Visual examinations
3.2.2.27.2	Identification plates for units, assemblies, subassemblies, and components	4.4.1.j	Visual examinations
3.2.2.27.3	Marking of sectionalized units	4.4.1.j	Visual examinations
3.2.2.27.4	Marking of plug-in assemblies	4.4.1.l	Visual examinations
3.2.2.27.5	Marking of fuse holders	4.4.1.l	Visual examinations
3.2.2.27.6	Marking of controls and indicating devices	4.4.1.l	Visual examinations
3.2.2.27.7	Marking of sockets	4.4.1.l	Visual examinations
3.2.2.27.8	Marking of printed wiring boards	4.4.1.l	Visual examinations
3.2.2.27.9	Marking of terminals, terminal blocks, and strips	4.4.1.l	Visual examinations
3.2.2.27.10	Marking of fluid and gaseous transmission lines	4.4.1.l	Visual examinations
3.2.2.27.11	Marking of fluid tanks and reservoirs	4.4.1.l	Visual examinations
3.2.2.27.12	Marking of reference designators	4.4.1.k	Visual examinations
3.2.2.27.12.1	Marking of cables and wires	4.4.1.k	Visual examinations
3.2.2.27.12.2	Marking of cables	4.4.1.k	Visual examinations
3.2.2.27.12.3	Marking of disconnectable cables	4.4.1.k	Visual examinations
3.2.2.27.12.3.1	Marking of "W" and "P" cable designations	4.4.1.k	Visual examinations
3.2.2.27.12.3.2	Marking of to-from designators	4.4.1.k	Visual examinations
3.2.2.27.12.3.3	Marking of assembly/part number	4.4.1.k	Visual examinations
3.2.2.27.13	Marking of optical fiber cables	4.4.1.k	Visual examinations
3.2.2.27.14	Marking of electrical power requirements	4.4.1.k	Visual examinations
3.2.2.27.15	Marking of trainer with modified, rejected, or non-operable parts	4.4.1.l	Visual examinations
3.2.2.27.16	Marking of parts that are modified, rejected, or non-operable	4.4.1.l	Visual examinations
3.2.2.27.17	Marking of safety hazards	4.4.1.l	Visual examinations
3.2.2.27.18	Marking of power switch warning plates	4.4.1.l	Visual examinations

TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.2.2.27.19	Marking of emergency power control switch	4.4.1.1	Visual examinations
3.2.2.27.20	Marking of ESD assemblies	4.4.1.1	Visual examinations
3.2.2.27.20.1	Marking of ESD sensitive assemblies	4.4.1.1	Visual examinations
3.2.2.27.20.2	Marking of ESD sensitive equipment	4.4.1.1	Visual examinations
3.2.2.27.20.3	Marking of external equipment terminals	4.4.1.1	Visual examinations
3.2.2.27.21	Marking of security cover	4.4.1.1	Visual examinations
3.2.2.27.22	Marking of hard cover	4.4.1.1	Visual examinations
3.2.2.27.23	Marking of lifting instructions for heavy trainers	4.4.1.1	Visual examinations
3.2.2.27.24	Marking center of balance	4.4.1.1	Visual examinations
3.2.2.28	Safety requirements	4.4.1.m	Visual examinations
3.2.2.28.1	Warning sign	4.4.1.m	Visual examinations
3.2.2.28.2	Warning lights	4.4.1.m	Visual examinations
3.2.2.28.3	Auditory sound level	4.4.1.m	Visual examinations
3.2.2.28.4	Temperature sensing alarms	4.4.1.m	Visual examinations
3.2.2.28.5	Equipment energized from multiple power sources	4.4.1.m	Visual examinations
3.2.2.28.6	Emergency equipment power disconnect	4.4.1.m	Visual examinations
3.2.2.28.7	Raised surfaces	4.4.1.m 4.4.1.n	Visual examinations Visual examinations
3.2.2.29	Workmanship	4.4.1.o	Visual examinations
3.2.2.29.1	Cleaning	4.4.1.o	Visual examinations
3.2.2.29.2	Threaded fasteners	4.4.1.o	Visual examinations
3.2.2.29.3	Wiring	4.4.1.o	Visual examinations
3.2.2.29.4	Shielding on wires and cables	4.4.1.o	Visual examinations
3.2.2.30	Modifications, changes, and configuration control	4.5.9.21	Modifications, changes, and configuration control test
3.2.2.31	Structural integrity	4.4.1.p	Visual examinations
3.2.2.31.1	Welded joints	4.4.1.p	Visual examinations
3.3	Availability requirements	4.5.9.22	Availability tests
3.3.1	Operational Availability ( $A_o$ ) requirements	4.5.9.22.1	$A_o$ test
3.3.2	Inherent Availability ( $A_i$ ) requirements	4.5.9.22.2	$A_i$ test
3.4	Reliability requirements	4.5.9.23	Reliability assessment
3.5	Maintainability requirements	4.5.9.24	Maintainability assessment
3.5.1	Accessibility	4.5.9.25	Accessibility test
3.5.1.1	Assemblies	4.5.9.25	Accessibility test



TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.5.1.2	Replacement of module assemblies	4.5.9.25	Accessibility test
3.5.1.3	Wiring board extender cards	4.5.9.25	Accessibility test
3.5.1.4	Covers, panels, and doors	4.5.9.25	Accessibility test
3.5.1.5	Removal, replacement, and movement of component parts	4.5.9.25	Accessibility test
3.5.1.6	Replacement of parts and microelectronic functional devices	4.5.9.25	Accessibility test
3.5.1.7	Lamps	4.5.9.25	Accessibility test
3.5.1.8	Cable slack	4.5.9.25	Accessibility test
3.6	Special tools	4.5.9.26	Special tools test
3.7	Trainer Computer System (TCS) requirements	4.5.9.27	TCS instructor and student station hardware tests
3.7.1	TCS instructor and student station hardware requirements	4.5.9.27	TCS instructor and student station hardware tests
3.7.1.1	TCS peripheral compatibility	4.5.9.27.1	TCS peripheral compatibility tests
3.7.1.2	Removable storage media for classified information	4.5.9.27.2	Removable storage media for classified information test
3.7.1.3	Processing resource and reserve capacity	4.5.9.27.3	Processing resource and reserve capacity tests
3.7.1.3.1	Spare main memory	4.5.9.27.3	Processing resource and reserve capacity tests
3.7.1.3.2	Spare mass storage	4.5.9.27.3	Processing resource and reserve capacity tests
3.7.1.3.3	Spare processing capacity	4.5.9.27.3	Processing resource and reserve capacity tests
3.7.1.3.3.1	Synchronous real-time functions	4.5.9.27.3	Processing resource and reserve capacity tests
3.7.1.3.3.2	Non-synchronous functions	4.5.9.27.3	Processing resource and reserve capacity tests
3.7.1.3.4	Spare input/output capacity	4.5.9.27.4	Spare input/output capacity tests
3.7.2	Trainer Computer System Software requirements	4.5.9.28	TCSS tests
3.7.2.1	Trainer system firmware	4.5.9.28.1	Maintenance, test, and diagnostic programs functional tests
3.7.2.2	TCSS retention	4.5.9.28.1	Maintenance, test, and diagnostic programs functional tests
3.7.2.3	Trainer computer software	4.5.9.28.1	Maintenance, test, and diagnostic programs functional tests
3.7.2.3.1	Real-time simulation, control, and processing programs	4.5.9.28.1	Maintenance, test, and diagnostic programs functional tests

TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.7.2.3.2	Utility programs	4.5.9.28.1	Maintenance, test, and diagnostic programs functional tests
3.7.2.3.3	Maintenance and test programs	4.5.9.28.1	Maintenance, test, and diagnostic programs functional tests
3.7.2.3.4	Computer diagnostic programs	4.5.9.28.1	Maintenance, test, and diagnostic programs functional tests
3.7.2.3.5	Operating system software	4.5.9.28.2	Operating system tests
3.7.2.3.6	Cycle time measurement programs	4.5.9.28.2	Operating system tests
3.7.2.3.7	TCSS source code	4.5.9.28.3	TCSS source code tests
3.7.2.3.8	Software configuration control tool	4.5.9.28.4	Software configuration control tool tests
3.7.2.3.9	Generating executable code and data files	4.5.9.28.5	Generating executable code and data files testing
3.7.2.3.10	Interactive creation and change	4.5.9.28.6	Interactive creation and change testing
3.7.3	TCS network	4.5.9.29	TCS network tests
3.8	Overlying architectures	4.5.9.30	Overlying architecture tests
3.8.1	High Level Architecture	4.5.9.30.1	HLA test
3.8.2	Joint Technical Architecture (JTA)	4.5.9.30.2	JTA test
3.9	Advanced Distributed Learning (ADL)	4.5.9.31	ADL test
3.10	Interactive Multimedia Instruction (IMI) material	4.5.9.32	IMI material test
3.11	Trainer accessory requirements	4.5.9.33	Trainer accessory tests
3.11.1	Casters	4.5.9.33.1	Casters test
3.11.2	Screw jacks	4.5.9.33.2	Screw jacks test
3.11.3	Forklift slots	4.5.9.33.3	Forklift slots test
3.11.4	Drip pans	4.5.9.33.4	Drip pans test
3.11.5	Covers	4.4.1.u	Visual examinations
3.11.5.1	Waterproof soft covers	4.4.1.f 4.4.1.o 4.4.1.q 4.4.1.u	Visual examinations Visual examinations Visual examinations Visual examinations
3.11.5.2	Waterproof hard covers	4.4.1.f 4.4.1.o 4.4.1.q 4.4.1.u	Visual examinations Visual examinations Visual examinations Visual examinations
3.11.5.3	Dust covers	4.4.1.u	Visual examinations
3.11.5.4	Security covers	4.4.1.l 4.4.1.u	Visual examinations Visual examinations

TABLE 4. Requirements to verification cross-reference - Continued.

SECTION 3. REQUIREMENTS		SECTION 4. VERIFICATION	
3.12	Environmental conditions	4.5.9.34	Environmental conditions test
3.13	Transportability and storage	4.4.1.s	Visual examinations
3.13.1	Assembly and disassembly for shipment	4.5.9.35	Assembly and disassembly for shipment test
3.13.2	Marking for shipment and storage	4.4.1.1	Visual examinations

4.4.1 Visual examinations. The trainer shall be subject to the visual examinations performed to demonstrate the trainer as-built design satisfies the specified requirements. The examinations will encompass all areas, major assemblies, and subassemblies of the areas of the completely assembled trainer. The examinations shall verify conformance to the requirements specified for:

- a. Fluids and gases.
- b. Materials.
- c. Parts.
- d. Components.
- e. Sectionalized units.
- f. Fasteners.
- g. Finishes and protective coatings.
- h. Panel plumbing.
- i. Antennas, dummy loads, and absorption enclosures.
- j. Data plates, identification plates, and markings.
- k. Marking of all cables and wires.
- l. All other marking requirements.
- m. Safety.
- n. Raised surfaces.
- o. Workmanship.
- p. Structural integrity.
- q. Assembly and fit.
- r. Dimensions and tolerances.
- s. Size, weight, and transportability.
- t. Color.
- u. Covers.

4.4.2 Safety inspections. The visual inspection shall consist of verification of the availability of trainer system documentation relative to testing requirements, and as an operational inspection of safety devices to determine compliance with specified requirements.

4.5 Functional tests. Functional tests shall include the verification and validation of design documentation and shall include the following tests:

4.5.1 Trainer functional performance test. The trainer functional performance shall be examined to determine that the designated functional characteristics are represented and that the realism, replication, representation, and stimuli facilitate the mastery of learning objectives. The examination shall be performed in a setting representative of the trainer operational setting using candidate students representative of the training target population. The evaluation will be based on the percentage of learning objectives supported as designated in the contract.

4.5.2 Simulation test. The trainer simulations shall be examined to determine that the simulation of functions and environment emulate the functions and environment of the represented equipment, systems, or missions. The simulations shall represent both normal operations and malfunctions of the represented equipment, systems, or missions. Simulations shall be examined to determine that they comply with the specified requirements in the HLA.

4.5.3 Animations test. The trainer visual subsystem shall be examined to determine whether the animations facilitate the mastery of the learning objectives and are scaleable and adaptable for various applications. Animations shall be examined to determine compliance with the requirements in MIL-PRF-29612 and the SCORM.

4.5.4 Animated electromechanical physical objects tests. Animated electromechanical physical objects shall be examined to:

- a. Determine that the panel type (i.e., 2-D or 3-D) trainer enhances the understanding of a component, system, process, or system operation.
- b. Determine that animatronics provide active interaction with an animated three-dimensional model of a living thing to facilitate the mastery of a learning objective.
- c. Determine that mission and scenario related animations provide active interaction with multiple animated three-dimensional models practice to facilitate the mastery of a learning objective.

4.5.5 Stimulator test. The trainer shall be examined to determine that it can be interconnected with military organizational equipment and can artificially create conditions that reproduce the sensory cues encountered in the operational environment.

4.5.6 Interaction and pacing test. The trainer shall be examined to determine that the interaction and pacing facilitate the mastery of the learning objectives.

4.5.7 Trainer tests. Trainers shall be examined to determine that the finished product facilitates instruction related to the end item and subsystem, mission, or program.

4.5.7.1 Maintenance trainer test. Maintenance trainers shall be examined to determine that the finished product facilitates instruction required for maintenance of the related end item and subsystems.

4.5.7.2 Operator trainer test. Operator trainers shall be examined to determine that the finished product facilitates instruction related to operation of the end item and subsystems. The trainer shall be examined to determine that the trainer facilitates the mastery of learning objectives for basic and advanced training of operations, maneuvering, and navigation. The trainer system shall be examined to determine that it provides a comprehensive set of cues required to initiate emergency procedures. The trainer software shall be examined to determine that it provides scenarios that for the student to practice the full-range of mission requirements.

4.5.7.3 Training equipment test. Training equipment shall be examined to determine that equipment groups, mock-ups, animated displays, task trainers, function trainers, and other equipment facilitate instruction related to the end item and subsystems.

4.5.7.4 Mission and scenario training system test. The mission and scenario training system shall be examined to determine that the training equipment has been combined in a manner that supports mission training exercises for individual or collective training. Additionally, software shall be examined to determine that it collects feedback and analyzes the actions of exercise participants.

4.5.8 Trainer interface test. Trainers and associated software shall be examined to determine that the interfaces support the instructor, student, and equipment interaction and communication requirements as follows:

4.5.8.1 Instructor-equipment interface test. Trainers shall be examined to determine that the instructor-equipment interface complies with the specified requirements.

4.5.8.2 Student-equipment interface test. Trainers shall be examined to determine that the student-equipment interface complies with the specified requirements.

4.5.8.3 Instructor-student interface test. Trainers shall be examined to determine that the instructor-student interface complies with the specified requirements.

4.5.8.4 Trainer-trainer-military organizational equipment interface test. Trainers shall be examined to determine that the trainer-trainer-military organizational equipment interface complies with the specified requirements.

4.5.9 Operational tests. Operational tests shall include the verification and validation of the trainer against the design documentation and shall include the following:

4.5.9.1 Software cold start test. Trainer software, including all databases, shall be subject to cold start testing. The cold start test shall commence with all trainer power removed and all main memory and on-line storage media formatted, but otherwise blank. The trainer computer system shall be energized and the cold start run in accordance with the detailed step-by-step procedures specified in the contract. The cold start shall include a complete system generation using only deliverable hardware, software, and documentation. All executable code shall be

created from the source programs and command or job control language and database source data. The process by which the cold start is accomplished (e.g., script, batch, job control file/program) shall be considered as software and shall be documented and controlled as such. The cold start process shall not suppress the generation of any error messages nor warnings that occur from the library, assembly, compile, or link processes. There shall be no errors nor abnormal conditions of any kind, including warnings, in either the source or resultant executable or database code prior to the start of testing (e.g., no error indications of any degree from the library, assembly, compile, or link processes). Should compiler or linker warnings be generated, they shall be documented and justified in the cold start procedure. All trainer performance tests during Government verifications shall utilize the executable and database code resulting from the cold start.

4.5.9.2 Trainee station tests. Trainee station tests shall consist of visual inspection to ensure weapon system equipment installation reflects the layout of the platform, weapon system memory load demonstration, readiness tests for weapon system equipment and TPE emulating weapon system equipment, suitability of controls and control circuits for satisfactory mechanical and electrical operation, control loading, canopy controls including safety requirements, crew station lighting, intercom controls and functions, and crew station egress procedures. Trainee station equipment operation, including all modes, shall be demonstrated and verified to operate as in the platform and in accordance with the specified performance requirements.

4.5.9.3 Instructor/student station tests. The input/output signals for the instructor/student stations tests shall consist, as a minimum, of system initialization, start-up readiness diagnostics, intercom controls and functions, instructor self-teaching capabilities, scenario load and initialization, and system mode selections including keyboard, track-ball, touch screen, display functions, and other peripherals, as applicable.

4.5.9.4 Visual system tests. Visual system tests shall consist, as a minimum, of verification of databases, image generator cold start, start-up self tests, off-line test pattern generation, brightness, resolution, cue synch, transport delay, and field-of-view.

4.5.9.5 Motion system tests. Motion system tests shall consist, as a minimum, of initialization including memory load, on-line calibrations, and demonstration of safety interlocks, emergency egress, and response characteristics.

4.5.9.6 Visual-motion synchronization test. The visual-motion synchronization test shall be conducted to determine that the transport delay between the student's input and the resulting change that appears in the visual display does not cause motion sickness.

4.5.9.7 Electrical tests. Electrical tests shall verify compliance with the specified electrical requirements. Electrical tests shall include power interrupt restarts. Electrical systems for use outside the CONUS shall be tested to verify that they operate from power sources of the host country.

4.5.9.8 Hydraulic and pneumatic power supply tests. Hydraulic and pneumatic power supplies shall be tested to verify they duplicate the actual end item and subsystem pressures to the extent required to facilitate mastery of the learning objectives. The pressure relief system and system emergency shutdown devices shall be tested to verify they function in accordance with the specified performance requirements.

4.5.9.9 Electronic transmissions test. When electronic emissions produce electromagnetic interference, the following tests shall apply:

4.5.9.9.1 EMI test. Trainers shall be tested to ensure that EMI generated by a subsystem or other subsystems and equipment does not degrade the overall system effectiveness. Trainers shall be tested to ensure requirements for electromagnetic compatibility comply with MIL-STD-461 and MIL-STD-464.

4.5.9.9.2 Electromagnetic radiation test. The trainer shall demonstrate that electromagnetic radiation is in accordance with the specified performance requirements.

4.5.9.9.3 ESD test. Electrical and electronic parts, assemblies, and equipment that are susceptible to damage from ESD shall be visually inspected to ensure they are marked in accordance with the requirements stated in 3.2.2.27.20.

4.5.9.9.4 TEMPEST test. Trainers shall be tested to ensure that the trainer does not unintentionally emit compromising emanations that could disclose classified information when it is transmitted, received, handled, or otherwise processed by any information processing equipment. If TEMPEST conditions cannot be avoided, the security procedures for TEMPEST shall be examined to ensure they comply with the requirements specified in the DoD 5220.22-M, NISPOM, Chapter 11, Section 1.

4.5.9.10 Power distribution tests. Power distribution shall be tested to verify that the following operate in the trainer's intended instructional environment in accordance with the specified performance requirements:

- a. Power distribution components.
- b. Power-line monitoring/protection.
- c. Under/overvoltage.
- d. Voltage transients.
- e. Phase rotation.
- f. Under-frequency.
- g. Frequency transients.
- h. Power interruption.

4.5.9.11 Elapsed time meter test. Time meters shall be tested to verify that the amount of time shown as elapsed during operation of the trainer indicates the precise amount of time for each independently operable trainer subassembly and subassembly group.

4.5.9.12 Malfunction control subassembly test. Trainer subassemblies shall be examined to determine that they contain switches and controls, hardware, and software that allow the instructor to select and enable simulated system malfunctions.

4.5.9.12.1 Malfunctions tests. Malfunction tests shall consist of operator initiated and simulation system scenario generated malfunctions. The trainer system indications and resultant system responses shall replicate the platform response to the same malfunctions.

4.5.9.13 Wiring and grounding systems test. Wiring shall be examined and tested to ensure compliance with the specified performance requirements. On-site grounding and grounding systems tests shall verify compliance with the specified grounding requirements.

4.5.9.14 Optical fiber cables and raceways test. Optical fiber cables and raceways shall be examined to ensure they comply with NFPA-70, Article 770.

4.5.9.15 Relay tests. Trainer peculiar relays shall be examined to ensure they comply with the specified performance requirements.

4.5.9.16 Power supplies test. Trainer power supplies including output power density and power supply derating criteria shall be examined and tested to ensure compliance with the specified performance requirements.

4.5.9.17 Microelectronic and thin film devices test. All microelectronic devices shall be examined to ensure compliance with performance requirements and to determine that they:

- a. Are of standard types.
- b. Are mechanically and electrically compatible.
- c. Are mounted in a manner that allows heat dissipation without the requirement for external support other than ambient air at room temperature.
- d. Are shielded to protect sensitive circuits against electromagnetic interference from conducted or radiated RF energy.
- e. Do not generate EMI that degrades the overall system effectiveness.
- f. Use one-position only plug-in modules.

4.5.9.18 Hydraulic and pneumatic power hose test. Hydraulic and pneumatic power hoses and connections shall be examined to ensure they comply with the performance requirements.

4.5.9.19 Human factors engineering compliance tests. The trainer shall be examined to determine that the trainer layout complies with the specified human factors engineering requirements.



4.5.9.20 Laser tests. Lasers used in trainers or training equipment shall demonstrate through functional test and documentation that they are in accordance with the specified performance requirements.

4.5.9.21 Modifications, changes, and configuration control test. The trainer shall be examined to determine that any modifications and changes induced by platform trainer improvements and safety requirements have been incorporated in the trainers and related components in accordance with the approved Configuration Management Plan.

4.5.9.22 Availability tests. Operational Availability ( $A_o$ ) and Inherent Availability ( $A_i$ ) tests are as follows:

4.5.9.22.1  $A_o$  test. The trainer  $A_o$  factor for scheduled operation in the training environment shall be 95 percent using the formula in Figure 6.

4.5.9.22.2  $A_i$  test. The trainer  $A_i$  factor shall be as specified in the contract using the formula in Figure 7.

4.5.9.23 Reliability assessment. The system-level reliability assessment shall demonstrate compliance with the specified quantitative reliability requirements (i.e., MTBF). The reliability assessment shall be performed concurrently with the other training system tests starting with the preliminary inspections and extending to the end of Government final acceptance. Data to be collected and tracked during the assessment period shall include trainer operating hours, failure occurrences, and the achieved MTBF. The following detailed testing requirements shall also apply:

- a. Failure criteria. All failures occurring during the reliability assessment shall be classified as relevant or nonrelevant. Relevant failures shall be further classified as chargeable and nonchargeable. Only those failures classified as chargeable shall be used for determining the achieved MTBF. The Government will make the final determination of failure classifications.
- b. Reliability test conditions. During the reliability assessment, the trainer shall be exercised at frequencies and durations typical of those occurring in normally scheduled training operations. The environmental conditions to be applied and their variation with time shall be representative of the actual operational environment at the trainer site. Electrical stresses shall include ON-OFF cycling and operation under the specified operating modes and duty cycles. The specific test conditions shall be in accordance with the Government-accepted Test and Evaluation Master Plan (TEMP).

4.5.9.24 Maintainability assessment. Concurrently with the reliability assessment period specified above, all trainer maintenance actions shall be monitored, recorded, and evaluated to demonstrate compliance with the specified MTTR requirement. MTTR elements subject to tracking during maintenance actions include failure isolation, disassembly, removal and replacement, reassembly, and checkout times.

4.5.9.25 Accessibility test. Accessibility characteristics shall be tested by performing maintenance, operator, and training tasks to determine that the accessibility characteristics comply with the specified performance requirements.

4.5.9.26 Special tools test. The trainer shall be examined to determine that necessary special tools are retained in holders provided inside the equipment and that the special tools are provided with the trainer.

4.5.9.27 TCS instructor and student station hardware tests. The trainer shall be tested to determine whether the TCS has peripherals, mass storage devices, and diagnostic programs that comply with the specified performance requirements.

4.5.9.27.1 TCS peripheral compatibility tests. Peripherals shall be connected to the TCS and tested to ensure they are compatible with the TCS and with other peripherals. Additionally, all peripherals shall be examined and tested to determine that they write and read in accordance with approved industry standards.

4.5.9.27.2 Removable storage media for classified information test. Removable storage media shall be examined to ensure the physical size allows for the storage in accordance with the specified performance requirements.

4.5.9.27.3 Processing resource and reserve capacity tests. The computer system shall be tested under worst-case trainer operations to ensure the processing resource and reserve capacity meet the performance requirements.

4.5.9.27.4 Spare input/output capacity tests. The spare input/output channel capacity shall be examined to ensure the capacity is no less than 20 percent of the installed input/output channel capacity. Additionally, the spare interface channels shall be examined to ensure they include analog-to-digital, digital-to-analog, digital-to-digital, discrete interface devices, and serial and parallel computer interface ports.

4.5.9.28 TCSS tests. The TCSS shall be tested to determine whether the computer system software, firmware, micro programs, and databases comply with the performance requirements.

4.5.9.28.1 Maintenance, test, and diagnostic programs functional tests. Maintenance, test, and diagnostic programs shall be examined to ensure that the computer systems programs meet the specified performance requirements.

4.5.9.28.2 Operating system tests. The operating system shall be tested to determine whether the computer software meets the operating time cycles.

4.5.9.28.3 TCSS source code tests. The source code listings, input/output parameters and locations, and media labeling (indexing) system shall be examined for compliance with the specified performance requirements.

4.5.9.28.4 Software configuration control tool tests. The software configuration control tool shall be tested to determine compliance with the specified performance requirements.

4.5.9.28.5 Generating executable code and data files testing. With the exception of commercial items, the trainer and the TCSS shall be tested to determine that compiled executable code and data files are generated in accordance with the specified performance requirements.

4.5.9.28.6 Interactive creation and change testing. The TCSS shall be tested for interactive creation and change of source code, raw data files, and other files as specified in the performance requirements.

4.5.9.29 TCS network tests. The TCS network shall be tested for compliance with the specified performance requirements.

4.5.9.30 Overlying architecture tests. The trainer, its hardware, simulations, and software shall be examined to determine compliance with the requirements stated in the HLA and JTA. The following tests apply:

4.5.9.30.1 HLA test. Simulations shall be examined to determine that they comply with the specified requirements in the HLA. Simulation software shall be tested to ensure compliance with the HLA rules, the HLA interface specification, and the HLA object model template as described in IEEE 1516-2000, IEEE 1516.1-2000, and IEEE 1516.2-2000.

4.5.9.30.2 JTA test. Trainers shall be examined and tested to determine compliance with the DoD's technical architecture requirements in the JTA.

4.5.9.31 ADL test. ADL products shall be examined and tested using the SCORM Test Suite to ensure the content conforms to the SCORM specifications.

4.5.9.32 IMI material test. IMI shall be examined and tested to ensure the IMI provides instructional material that facilitates mastery of the learning objectives being taught with the trainer. IMI shall contain the data and have the functional requirements specified in MIL-PRF-29612.

4.5.9.33 Trainer accessory tests. The following trainer accessories shall be tested to ensure compliance with the performance requirements:

4.5.9.33.1 Casters test. The casters on all trainers and subassemblies weighing in excess of 75 pounds (when in transportation configuration) shall be examined and tested to ensure compliance in accordance with the specified performance requirements.

4.5.9.33.2 Screw jacks test. The screw jacks shall be examined and tested to ensure compliance in accordance with the specified performance requirements.

4.5.9.33.3 Forklift slots test. All trainers and subassemblies weighing in excess of 75 pounds shall be examined to ensure they contain forklift slots for transportation purposes.

4.5.9.33.4 Drip pans test. Trainers with liquid systems shall be examined to determine that under each liquid system there are detachable drip pans with readily accessible low-point drain valves.

4.5.9.34 Environmental conditions test. Trainers shall be tested to the training, transportation, and storage environment thresholds specified in the TEMP.

4.5.9.35 Assembly and disassembly for shipment test. Trainers shall be tested for ease of disassembly and reassembly. The test shall be conducted by following the contractor's instructions for disassembly and reassembly step-by-step to determine that the instructions are complete, easy to read and can be followed without outside assistance, and that the reassembled product is operational.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, Compact Disc-Read Only Memory (CD-ROM) products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The operator and maintenance trainers and related items specified herein are intended for use by the students in the performance of trainer exercise (i.e., operate, repair, servicing, adjustment and troubleshooting of the various systems, subsystems, installations, components, and equipment of the related series end items and subsystems, test equipment and SE applicable thereto at the specified levels of maintenance).

6.1.1 Separate procurement. This specification may be utilized for separate procurement of operator and maintainer training equipment. The purpose of this training equipment is to support organizational and intermediate level maintenance and operator training of the related end item.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number and date of the specification.
- b. Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2.1).
- c. Packaging requirements (see 5.1).
- d. The type of verification inspection (first article or quality conformance inspection, or both) required (see 4.1).
- e. The verification examinations that will be required. Include any additional or alternate verification criteria (see Section 4).
- f. How and when the verification inspections will be performed (e.g., in-plant, on Government site, progress reviews, acceptance inspections) (see Section 4).
- g. The activity (contractor or Government) that will perform the verification examination.
- h. The activity (contractor or Government) that will perform the verification evaluation.
- i. The required service life of the trainer.
- j. When necessary to utilize TEMPEST countermeasures, identify in writing what TEMPEST countermeasures may be required. Identify any TEMPEST requirements within the United States to the Cognizant Security Agency for approval prior to imposing requirements for TEMPEST countermeasure upon a contractor.
- k. Additional data that is required on the trainer data plate(s).
- l. Additional requirements for marking trainers to provide safety warnings/instructions for the protection of personnel. Requirements to mark all potentially hazardous items (e.g., high-voltage wiring, high-pressure lines, chemicals, electronics radiating RF energy, noise levels, lasers, fast acting mechanisms).
- m. Identify the Inherent Availability (A<sub>i</sub>) requirements.
- n. Identify reliability requirements if different from the requirements in 3.4.
- o. Identify maintainability requirements if different from the requirements in 3.5.
- p. TCSS system operational reserve capacities.
- q. Trainer computer software not specified in this performance specification.
- r. Detailed requirements for trainer accessories (e.g., casters, jacks).
- s. According to the intended use, modify the Table 3 environmental conditions and requirements and add the temperature range required for the trainer's intended use.
- t. Transportability and storage requirements. Modes of transportation to be used for the trainer (e.g., air, truck, rail, ship).
- u. Data product requirements and applicable Data Item Descriptions (DID).
- v. Service requirements (e.g., trainer refurbishment, specification maintenance).
- w. When an OSHA approved safety color is required, specify FED-STD-595 red paint color number of 11120, 11105, or 11140. (These FED-STD-595 colors meet OSHA requirements.)
- x. Identify other equipment to be included with the specified device in the HLA federation.

6.3 Technical manuals. The requirement for technical manuals should be considered when this specification is cited. If technical manuals are required, specifications and standards that have been cleared and listed in DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL) must be listed on a separate Contract Data Requirements List (DD Form 1423) that is attached as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

6.4 Tailoring guidance. Tailoring is the process by which individual requirements (e.g., sections, paragraphs, sentences) of specifications, standards, and related documents are modified to ensure an optimal balance between operational needs and cost. Tailoring specifications may involve the deletion, addition, or alteration of performance and verification requirements. This specification is written and structured so that referenced documents, requirements, and verification provisions can be readily tailored to suit different applications. Each training program is unique; therefore, this specification must be tailored to avoid buying unnecessary features and equipment. Proper tailoring of requirements is vital to a sound, cost effective, and supportable training program. Preparers of solicitations and contracts should tailor the requirements of Sections 3 and 4 of this specification to ensure proper application.

6.5 Acronyms and definitions. Acronyms and definitions for terms used in this document are provided below.

6.5.1 Acronyms used in this specification are as follows:

<u>ACRONYM</u>	<u>LONG TITLE</u>
ADL	Advanced Distributed Learning
A <sub>i</sub>	Inherent Availability
A <sub>o</sub>	Operational Availability
AMSDL	Acquisition Management Systems and Data Requirements Control List
ANSI	American National Standards Institute
APSE	All Program Support Environment
ASCII	American Standard Code for Information Interchange
ASME	American Society of Mechanical Engineers
BHMA	Builders Hardware Manufacturers Association
CAGE	Commercial and Government Entity
CaNDI	Commercial and Non-Developmental Item
CAOE	Contractor-Acquired Operational Equipment
CD	Control Drawing
CD-ROM	Compact Disc-Read Only Memory
CFR	Code of Federal Regulations
CONUS	Continental United States
CPU	Central Processing Unit
DID	Data Item Description

<b><u>ACRONYM</u></b>	<b><u>LONG TITLE</u></b>
DoDISS	Department of Defense Index of Specifications and Standards
EIA	Electronic Industries Alliance
EMI	Electromagnetic Interference
EPA	Environmental Protection Agency
ESD	Electrostatic Discharge
FDA	Food and Drug Administration
FET	Field Effect Transistor
GFE	Government Furnished Equipment
HLA	High Level Architecture
ICW	Interactive Courseware
ID	Identification
IEEE	Institute of Electrical and Electronics Engineers
IMI	Interactive Multimedia Instruction
JTA	Joint Technical Architecture
ma	Milliamperes
MCMT	Maximum Corrective Maintenance Time
MLDT	Mean Logistics Delay Time
MPMT	Mean Preventative Maintenance Time
M&S	Modeling and Simulation
MTBF	Mean Time Between Failure
MTTR	Mean Time To Repair
NDI	Non-Developmental Item
NFPA	National Fire Protection Agency
NISPOM	National Industrial Security Program Operating Manual
NSN	National Stock Number
ODS	Ozone Depleting Substance
OMT	Object Model Template
OSHA	Occupational Safety and Health Administration
OSI	Open System Interconnection
PCO	Procurement Contracting Officer
QPL	Qualified Products List
RF	Radio Frequency
RFI	Ready for Issue
SCORM	Sharable Content Object Reference Model
SE	Support Equipment
TPE	Trainer Peculiar Equipment
TCS	Trainer Computer System
TCSS	Trainer Computer System Software
TEMP	Test and Evaluation Master Plan
URL	Uniform Resource Locator
VDC	Volts Direct Current

6.5.2 Definitions. Throughout this specification, various terms are used which could be subject to varying definitions. For this specification, these terms are specifically defined as follows:

- a. Availability. Availability is a measure of the operational state of a trainer in its training environment. (Definitions for Inherent Availability ( $A_i$ ) and Operational Availability ( $A_o$ ) are applicable.)
- b. Combination platform/component/simulator (i.e., hybrid) trainers. A combination of systems utilizing actual components and simulated components functioning to provide a replica of the systems as installed. Can be designed with varying combinations of hardware and simulation dependent upon specified objectives and planned student terminal competency. Actual system components may be used, stimulated, or simulated, or a combination of these methods may be used.
- c. Commercial item. Per the Federal Acquisition Regulations, Part 2.101, "Commercial item" means:
  - (1) Any item, other than real property, that is a type customarily used for nongovernmental purposes and that:
    - (a) Has been sold, leased, or licensed to the public.
    - (b) Has been offered for sale, lease, or license to the public.
  - (2) Any item that evolved from an item described in paragraph a. of this definition through advances in technology or performance and that is not yet available in the commercial marketplace, but will be available in the commercial marketplace in time to satisfy the delivery requirements under a Government solicitation;
  - (3) Any item that would satisfy a criterion expressed in paragraphs (1) or (2) of this definition, but for:
    - (a) Modifications of a type customarily available in the commercial marketplace.
    - (b) Minor modifications not customarily available in the commercial marketplace, made to meet Federal Government requirements. Minor modifications means modifications that do not significantly alter the nongovernmental function or essential physical characteristics of an item or component, or change the purpose of a process. Factors to be considered in determining whether a modification is minor include the value and size of the modification and the comparative value and size of the final product. Dollar values and percentages may be used as guideposts, but are not conclusive evidence that a modification is minor.
  - (4) Any combination of items meeting the requirements of paragraphs (1), (2), (3), or (5) of this definition that are of a type customarily combined and sold in combination to the general public.



- (5) Installation services, maintenance services, repair services, training services, and other services if such services are procured for support of an item referred to in paragraphs (1), (2), (3), or (4) of this definition, and if the source of such services:
    - (a) Offers such services to the public and the Federal Government contemporaneously and under similar terms and conditions.
    - (b) Offers to use the same work force for providing the Federal Government with such services as the source uses for providing such services to the public.
  - (6) Services of a type offered and sold competitively in substantial quantities in the commercial marketplace based on established catalog or market prices for specific tasks performed under standard commercial terms and conditions. This does not include services that are sold based on hourly rates without an established catalog or market price for a specific service performed.
  - (7) Any item, combination of items, or service referred to in paragraphs (1) through (6), notwithstanding the fact that the item, combination of items, or service is transferred between or among separate divisions, subsidiaries, or affiliates of a contractor.
  - (8) A nondevelopmental item, if the procuring agency determines the item was developed exclusively at private expense and sold in substantial quantities, on a competitive basis, to multiple State and local governments.
- d. Cutaway component. A component that has had a portion of the external housing removed to display the internal portion to the maximum extent possible for instructional purposes.
- e. End item. A specific type/model/series aircraft, missile, tank, ship, system, subsystem, assemblies, subassemblies, or equipment that the trainer is to emulate.
- f. Free-play. An unstructured mode of instruction that allows the student to freeze the simulation, select malfunctions, and record, replay, and reset the lesson at any time during the session. The software responds to the student's input and emulates the operation and performance of the actual end item being represented.
- g. Government Furnished Equipment (GFE). Government-owned equipment provided to the contractor for installation on, or in support of the trainer. GFE includes the following categories:
- (1) End item and support equipment technical manuals.
  - (2) Government installed military organizational equipment.
  - (3) Contractor installed military organizational equipment.
  - (4) Common support equipment.
  - (5) Peculiar support equipment.
  - (6) Test equipment.
- h. Inherent Availability ( $A_i$ ) requirements. Inherent availability ( $A_i$ ) is measured in terms of reliability and maintainability. The formula for  $A_i$  is as follows:

$$A_i = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR}}$$

- i. Laser. Lasers are devices that can be made to produce or amplify electromagnetic radiation. Lasers emit lightwave energy for use in the medical field and tactical environment. Lasers are classified by 21 CFR 1041.10 as follows:
  - (1) Class I. Class I levels of laser radiation are not considered to be hazardous.
  - (2) Class II. Class II levels of laser radiation are considered a chronic viewing hazard.
  - (3) Class IIa. Class IIa lasers are not considered hazardous if viewed for a period less than or equal to ten (10) seconds and are considered a chronic viewing hazard if viewed for a period greater than ten (10) seconds.
  - (4) Class IIIa. Class IIIa lasers are considered either an acute intrabeam viewing hazard or chronic viewing hazard (depending upon the irradiance), and an acute viewing hazard if viewed directly with optical instruments.
  - (5) Class IIIb. Class IIIb levels of laser radiation are considered an acute hazard to the skin and eyes from direct radiation.
  - (6) Class IV. Class IV levels of laser radiation are considered to be an acute hazard to the skin and eyes from direct and scattered radiation.
- j. Maintenance trainer. Provides training for the operation, location, inspection, testing, troubleshooting, removal, installation, and checkout of end item systems, subsystems, parts, and SE.
- k. Military organizational equipment. Actual equipment designed for use by operational units to accomplish their mission, as distinguished from that equipment designed only for training purposes.
- l. Non-Developmental Item (NDI). Per the Federal Acquisition Regulations, Part 2.101, NDI means:
  - (1) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;
  - (2) Any item described in paragraph (1) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency.
  - (3) Any item of supply being produced that does not meet the requirements of paragraph (1) or (2) solely because the item is not yet in use.
- m. Operational Availability ( $A_o$ ) requirements.  $A_o$  is a function of the relationships among hardware, personnel, and procedures. The trainer operational availability factor for

scheduled operation in the training environment shall be a minimum of ninety-five hundredths (0.95) based on the following formula:

$$A_o = \frac{\text{Up Time}}{\text{Up Time} + \text{Down Time}} = \frac{\text{MTBF}}{\text{MTBF} + \text{MTTR} + \text{MLDT}}$$

- n. Optical fiber cable. Optical fiber cables transmit light for control, signaling, and communications through an optical fiber. Optical fiber cables are grouped into three types; 1) Nonconductive optical fiber cables, 2) conductive optical fiber cables, and 3) composite cables (i.e., optical fibers). For additional information, refer to NFPA 70, Article 770.
- o. Ozone Depleting Substance. Any substance the EPA designates in 40 CFR part 82 as:
  - (1) Class I, including, but not limited to, chlorofluorocarbons, halons, carbon tetrachloride, and methyl chloroform.
  - (2) Class II, including, but not limited to, hydrochloroflourocarbons.
- p. Plasticized component. A component that has all, or a portion of, its external housing removed and replaced with a transparent plastic composition allowing visual inspection of the component's internal mechanism.
- q. Platform and component trainers. Utilizes actual system components which function in the same manner as when installed in the end item. Uses actual system, subsystems, and assemblies located as close as possible to their location in the end item. The trainer includes actual wiring, plugs, mounting racks, securing devices, and any other common hardware deemed necessary to enhance the realism of training.
- r. Simulator trainer. Equipment that emulates the functions and environment of actual equipment or systems. Any training device, machine, or apparatus that reproduces a desired condition or set of conditions synthetically. Specifically for training, a relatively complex item of training equipment, using electronic/mechanical means to reproduce conditions necessary for an individual, or a crew, to practice operational exercise in accordance with training objectives. Represents the military organizational equipment physically and functionally to varying degrees.
- s. Subassembly group. Two or more trainer subassemblies that require assembly into a single unit to operate as a trainer. Individual subassemblies of the subassembly group can not operate independently. The subassembly group is disassembled into individual subassemblies only for repair, relocation, or shipping purposes.
- t. Support Equipment. Comprised of only those general-purpose items supplying or measuring broad parameters of physical properties that are known to be established in the using service's inventory (e.g., ground electrical, pneumatic, hydraulic power units; towing, hoisting, and fueling devices; signal generation devices; voltage, amperage, phase measuring devices). For the purpose of this document, the following equipment is excluded from the definition of SE:

- (1) Common powered and non-powered hand tools.
  - (2) Housekeeping items.
  - (3) Office furniture and equipment, and items common to all activities defined in applicable tables of allowance, and that are required as indirect support.
  - (4) Common production tools and tooling (e.g., lathes, drills, presses, plating equipment, grinders, induction heaters, etc.).
  - (5) Items that are used only by the contractor.
  - (6) Personal equipment (e.g., headsets, microphones, etc.).
- u. TEMPEST. An unclassified short name referring to investigations and studies of compromising emanations. Compromising emanations are unintentional intelligence-bearing signals that, if intercepted and analyzed, will disclose classified information when it is transmitted, received, handled, or otherwise processed by any information processing equipment.
- v. Trainer. Hardware and software, designed or modified exclusively for training purposes, involving simulation or stimulation in its construction or operation to demonstrate or illustrate a concept or simulate an operational circumstance or environment.
- w. Trainer Peculiar Equipment. The following types of equipment are defined as TPE:
- (1) Trainer equipment which has not been classified by the Government as a Commercial item, "NDI that is exempt from TPE requirements", GFE, or CAO, and which is to be delivered to the Government as a result of the requirements of the contract.
  - (2) Trainer equipment, which is to be delivered to the Government as a result of the requirements of the contract, which has been classified as a Commercial item, NDI, GFE, or CAO, and:
    - (a) Needs other than minor modifications or modifications which are not of a type customarily available in the commercial marketplace to meet the requirements of the contract.
    - (b) Has insufficient existing product documentation for Government logistics support.
- x. Trainer subassembly. A portion of a trainer that is normally used in conjunction with other related trainer subassemblies.
- y. Trainer Computer System Software. All software executed during trainer operation such as the programs used in training and scenario development, the computer operating system, software used for test and maintenance of the trainer system (e.g., diagnostic packages, training test programs), and software used to develop and support the trainer system. The terms computer program, system software, software, and program are used synonymously within this standard.
- z. Training equipment. Hardware or software in the form of system, subsystems, parts, or components (actual, duplicated, simulated or otherwise represented) and supporting materials, to be used by the student and instructor to achieve required skill levels.

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Training equipment includes end items or systems that have been modified for training. The primary items that individually or collectively comprise a trainer consist of:

- (1) Equipment groups.
- (2) Mock-ups.
- (3) Animated displays (i.e., multimedia).
- (4) Requisite electrical, hydraulic, and pneumatic power supplies.
- (5) Environmental control equipment.
- (6) Repair parts.
- (7) Support equipment.
- (8) Related items as specified in the contract.

6.6 Subject term (key word) listing.

Operator Trainers  
Maintenance Trainers  
Equipment Trainers  
Operator Training Services  
Maintenance Training Services  
Equipment Training Services

CONCLUDING MATERIAL

Custodians:

Army -AV  
Navy - AS  
Air Force -94  
Marine Corps - MC  
Coast Guard -  
DLA - DH

Preparing Activity:

Navy - AS  
(Project: SESS-0020)

Review Activities:

Army - TM  
Navy - SH, EC, TD  
Air Force - 11  
NSA - NS  
DLA - CS, GS, IS, DP

# STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

## INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7, and send to preparing activity.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

### I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

2. DOCUMENT DATE (YYYYMMDD)

### 3. DOCUMENT TITLE

### 4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

### 5. REASON FOR RECOMMENDATION

### 6. SUBMITTER

a. NAME *(Last, First, Middle Initial)*

b. ORGANIZATION

c. ADDRESS *(Include ZIP Code)*

d. TELEPHONE *(Include Area Code)*

(1) Commercial

(2) DSN  
*(If applicable)*

7. DATE SUBMITTED  
(YYYYMMDD)

### 8. PREPARING ACTIVITY

a. NAME  
COMMANDER  
NAVAL AIR WARFARE CENTER  
AIRCRAFT DIVISION

b. TELEPHONE *(Include Area Code)*

(1) Commercial  
(732) 323-2947

(2) DSN  
624-2947

c. ADDRESS *(Include ZIP Code)*  
CODE 414100B120-3  
HIGHWAY 547  
LAKEHURST, NJ 08733-5100

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